ELECTRICAL REVIEW
AND
WESTERN ELECTRICIAN

VOL. LIV, No. 10. CHICAGO, SATURDAY, MARCH 6, 1909. ISSUED WEEKLY

BY THE
ELECTRICAL REVIEW PUBLISHING COMPANY.

CHARLES W. PRICE, President.
H. S. TUTHILL, Secretary. PHILIP S. DODD, Manager.
C. W. FORBRICH, Assistant Treasurer.

PUBLICATION OFFICE: 204 DEARBORN STREET, CHICAGO.

EASTERN DEPARTMENT . . . . . 13 Park Row, New York. E. E. Wood.
EUROPEAN OFFICE . . . . . 42 Old Broad Street, London, E. C. Henry W. Hall.

A. A. GRAY, Managing Editor.

The present publication comprises: ELECTRICAL REVIEW, VOL. LIV, No. 10; WESTERN ELECTRICIAN, VOL. XLIV, No. 10.

SUBSCRIPTIONS

One Year, United States $3.00
One Year, Canada 4.00
One Year, Foreign Countries 6.00
Single Copy, 10 cents. Back numbers, beyond one month, each . .25

Changes of address reaching this office later than Monday cannot be made until the issue next following.

Entered as second-class matter, November 7, 1908, at the Post Office at Chicago, Ill., under the Act of March 3, 1879.

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FIRE PROTECTION IN SUBSTATIONS.

From the standpoint of fire risk the average electric railway or power substation of modern design offers perhaps as little danger as any well-built industrial structure. In comparison with the power plant in which steam generating or gas-operated equipment is in service the substation is, of course, much simpler in its composition, and is usually constructed along lines tending to prevent the occurrence of a fire from any of the machines housed within it. Many power stations are still handicapped by the installation of apparatus of high power in unsuitable frame structures which are the inheritance of past practice; and again, the division of the power plant into sections where oily refuse can more easily collect tends to make the fire risk higher than in the substation, which often consists of but one or two rooms without a basement. When a fire does occur in a substation, however, the conditions deserve careful study, for the use of high voltages on the lines entering and leaving the premises often leads to serious trouble when the installation is in any way defective.

A recent substation fire which illustrates these points occurred in a rotary converter installation housed in a building of brick, cement and steel. The fire was started by lightning, which entered the substation during a severe storm. The discharge was not properly taken care of by the lightning arresters, and the current jumped to the brick wall of the building, setting fire to the insulation on the high-tension wires and the wooden framework which supported the lightning arrester equipment. The substation attendant immediately telephoned to the police, who notified the company's chief electrician, and the latter went directly to the substation. Meanwhile the attendant and his assistant attempted to put out the fire with pails of sand, one of these meeting with disaster as a result of a shock which he received when he tried to take down a pail of sand hanging on the brick wall about five feet away from the high-tension wires. The fire burned until the current was shut off at the power station, after which it was extinguished with sand. The building was not damaged, but one set of lightning arresters and the wooden framework carrying them, including porcelain insulators on the wire, were seriously damaged. The total property loss was only about $75.

The cause of the failure of the lightning arresters was difficult to determine on investigation. It was found that the building itself was not struck, but that the discharge was carried to the station by the 13,200-volt lines which entered it. The lightning arrester equipment was of wooden style and of

a make approved by the insurance interests. The ground connection consisted of a No. 4 B. & S. wire carried through the floor and out through the wall, thence to a ground which consisted of old trolley wire twisted up and buried about five feet below the surface of the ground. The soil at the substation is practically always moist, the location being in a marsh which is at times under tide water, but the presence of buildings all around the substation tended to interfere with a good ground connection. It was considered probable that in the case above outlined the ground connection was not perfect enough to carry off the discharge. The appearance of the lightning arresters indicated that they worked properly. In view of the importance of having a better ground connection it was recommended that in addition to the previous arrangement a copper plate be provided at least two feet square by one-sixteenth of an inch thick and buried in the earth in fine crushed charcoal at least six feet below the surface in soft soil. Also it was advised that connections be made between the arresters and this plate by a continuous copper strip one inch wide and one-sixteenth inch thick, run in as nearly a straight line as possible, bushed with porcelain tubes through walls and floors and attached to the plate by solder and rivets. Connection was also to be made with the rails of the system by a cable leading from the ground plate. Finally it was decided to keep pails away in the future from the vicinity of all high-tension wiring and lightning arrester apparatus.

BOOSTING THE USE OF ELECTRIC VEHICLES IN NEW ENGLAND.

Announcement is made of the formation of an organization to bring together manufacturers of electric vehicles, battery manufacturers and central-station men in New England. Plans have been discussed for co-ordinating the efforts of the various industries represented, that the public may be made aware of the great utility of electrically driven vehicles. In the issue of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for February 13, it was our good fortune to point out the possibility of such co-ordinated effort, and we are glad indeed to note the substantiation of our suggestion in the organization just referred to.

The electric vehicle is essentially the proper equipment for shopping trips; for the doctor who must depend upon a machine to be in readiness day or night, and which he can manipulate himself without fuss or bother and without calling upon a professional driver. The noiselessness and ease of control of the electric vehicle make it the perfect machiné for ladies' use, and for threading in and out the busy city traffic the business man for his short trips finds it an especially agreeable mode of travel. The new association should meet with immediate success. There has been need of such an organization for a long time, and it is hoped that everyone interested will heartily support the idea and lend strength to the movement by contributing in every direction those elements which may be necessary to give it standing and increase its usefulness.

MUSICAL INTERPRETATION BY ELECTRICITY.

One of the most remarkable features of modern electrical development is its continued application to new fields where flexibility and convenience are served as never before. In many cases electricity supplies means of operation or demonstration which were next to impossible before the new adaptation was made, and as the extension of service proceeds into all departments of human interest we shall undoubtedly find multiplied applications which are at present entirely unthought of by workers in well-tried fields. One of the latest applications of this character has been made in connection with the interpretation of music before student classes through the use of colored incandescent lamps. In the lecture recital the auditorium is darkened and the performer is located behind a screen. Each selection is first explained in a few words and the principal theme and subsidiary phrases played separately. Then, when the selection is played as a whole, the sequence of parts is indicated by different colored incandescents, a red lamp being shown during the playing of the principal theme, a blue lamp being switched on when the subtheme appears, and a white light being shown when incidental parts are played. By this arrangement even those unfamiliar with classical music can listen more intelligently and the analysis of the composition can be much facilitated.

Of course this arrangement is simple in the extreme from the electrical point of view, but it suggests that if the matter is followed more closely and developed, remarkable possibilities exist in connection with the interpretation of complex music by electrical means. Even to the ear of the experienced listener the storm of complex sound waves which flood a great music hall during the performance of a piece like Beethoven's Fifth Symphony is not interpreted without much receptive exertion. If the harmonious vibrations could be made visible to the eye at the same time, would not the capacity for enjoyment be heightened? Certainly the interweaving of the fundamentals and overtones of a hundred instruments, if made visible, would be a marvelously instructive sight. As an aid to the composer, might not the visual display of musical tones be a supplementary convenience? Shall we not some day have chords in color as well as in auditory vibrations? Obviously the use of a few incandescent lamps to pilot the inexperienced listener through the strains of a Wagner opera is a far different thing from the development of spectroscopic harmonies capable of indicating the more subtle relations of tone. A beginning might be made by using different colored lamps in the circuits of church organ electromagnets; from that point, if the experiments work out well, it may be possible to utilize the telephone transmitter in connection with some as yet undeveloped apparatus for transposing sound into light vibrations, so that a band of colors on a screen will wax and wane in relation to the tone variations of a musical selection. In this borderland between electrophysics and the physics of music there is much territory remaining to be explored, and there is no question about electrical methods being the most delicate and flexible available for investigation.

THE MILEAGE RADIUS OF ELECTRIC VEHICLES.

On another page of this issue Mr. Frank B. Rae discusses the subject of the distance which may be traveled by an electric vehicle on a single charge. This distance will depend upon many conditions, all of which are variable. A statement as to the mileage a car will make in a day's run, unqualified by a number of considerations which may affect the distance which the car will travel, is bound to be outside of the limits of correctness nine times out of ten.

Attention is now being directed toward the electric vehicle, and this has been brought about through the efforts largely of those enterprising manufacturers who, in the face of considerable difficulty, have developed a line of electric vehicles which upon merit alone has won the confidence and popularity of city users of the horseless carriage.

Mr. Rae's contribution is timely and we believe will be read with interest by engineers and central-station operators. The figures given are the result of careful trial and represent an important analysis of the power requirements of electric vehicles, pointing out essentially that the radius of travel is dependent largely upon the mechanical construction of the running gear and transmission. The point is also clearly indicated that the different rates of travel calling upon the batteries for a varying quantity of discharge, will influence largely the mileage radius. Mr. Rae's assumptions are based upon an eight-hour rate of discharge. This eight-hour rate, however, is the standard for stationary batteries, but with batteries for electric vehicles the practice among manufacturers is to rate the batteries on a four-hour discharge. This consideration will somewhat affect the conclusions enunciated in the article.

THE ELECTRIC FURNACE.

For some time we had been waiting for news concerning developments in the electric furnace which would indicate its more rapid entrance into practical commercial enterprises. The results secured recently by Stassano, Girod, Kjellin, Gin and Héroult, in the electric refining of steel have kept alive the hope that some large organization would take up the matter on a broad scale and determine upon the solution of some of the problems which are yet unsolved to give a greater sphere of usefulness to the purely electrical refining of metals. It has been pointed out from time to time that for the overall method of refining steel, particularly for steels of lower grades, that the electric furnace could hardly compete with the older open-hearth and Bessemer processes.

The announced decision of the United States Steel Corporation to build a fifteen-ton Héroult plant at the South Chicago mills of the Illinois Steel Company, and another at the Worcester mills of the American Steel and Wire Company, brings the electric furnace into immediate prominence and gives promise of important developments. The furnace at South Chicago, it is understood, will be used for the making of a high-grade steel for special rails. That at Worcester will be used for new steel for special wire.

The Steel Corporation is going about the matter in what appears to be the right direction, as it is intended to deliver to the electric furnace hot metal from a Bessemer converter, refining the molten metal until it excels in quality any rail metal now produced. Open-hearth furnaces will be used to feed the electric furnace at Worcester, and in both cases the electric furnace will be used as a link in the chain of smelting and refining. In this way the greatest technical refinement can be concentrated at the end of the process, and it is expected that a new step in metallurgical work will have been accomplished when these furnaces are put in operation.

OPERATING RESULTS OF THE ELECTRIFICATION OF THE ST. CLAIR TUNNEL.

In a recent paper, Mr. H. L. Kirker, of the Westinghouse Electric and Manufacturing Company, presented some interesting figures concerning the operating results of the electrification of the St. Clair tunnel. It will be remembered that quite recently the tunnel under the St. Clair River of the Grand Trunk Railway, connecting Port Huron, Mich., with Sarnia, Ontario, was placed under electrical operation, 11,000-volt, single-phase alternating current being used. This electrification was described and illustrated in Vol. LIII, page 766.

The single-phase electric locomotives handle 1,000-ton trains, where the steam locomotives handled 700-ton trains. The electric locomotives climb the two per cent grades at ten miles an hour, where the steam locomotives were barely able to pull out at three miles an hour. The running time from summit to summit with electric locomotives is ten minutes and the average number of cars per train is 27.3. Under steam conditions the average time from summit to summit was fifteen minutes and average number of cars 19.7.

During the first twenty-hour hours of continuous electric service, 1,529 freight cars and the usual number of passenger trains were put through the tunnel. This compares with the best record for steam operation of 1,501 freight cars and the usual number of passenger trains.

The fuel bill for steam locomotives during the last six months in steam service, averaged $4,956 a month. The fuel bill for the first six months of electric service averaged $1,152.60 a month. Hard coal, costing $6 a ton, was used on the steam locomotives. Bituminous coal, costing $2 a ton, is used in the tunnel power station. The maintenance cost for the steam locomotives averaged 13.6 cents per locomotive-mile, while that of the electric locomotive averaged 4.3 cents per locomotive-mile during the first three months of service.

The electric locomotives have shown high efficiency in service, have required few repairs, and these have been the result of poor workmanship rather than because of any essential defect in the system. There has been but little trouble with the overhead construction, and the contributory advantages, such as better atmospheric conditions in the tunnel, the elimination of possibility of break-ups, the ability to utilize air brakes, and the possibility of considerable expansion of traffic without increasing rail facilities, make this one of the most successful of recent electrifications of trunk-line service.

THE MILEAGE RADIUS OF ELECTRIC VEHICLES.

BY FRANK B. RAE.

The distance that may be traveled by an electric vehicle upon a single charge of its storage battery, depends upon a number of conditions, all variable. Any statement as to the mileage a car will cover in a day's run must consider all these conditions, and it is therefore obvious that mileage can only be approximated. The energy, expressed in horsepower, necessary to move a car of given weight, over a level road of known construction and at a given speed may be closely predetermined, but the element of road friction, or resistance to traction due to road and wind resistances, alters for every change of speed and for different makes of tires. The efficiency of the motor and the efficiency of battery discharge is also variable and alters with the current consumption, and the effect of the latter upon the voltage.

The knowledge of motor design is today so far advanced that differences in efficiency between different makes each operating at its best speed and rated current input, will not vary materially, and the chief, if not the only, difference to be found between rival cars (assuming them alike in weight, make of tires and battery capacity) as regards their ability to go a greater or less distance on a level road, would be due almost entirely to difference in mechanical construction in which one car would have less gear and bearing friction than the other.

The horsepower necessary to move a rolling load of given weight on a level road at a given speed is the same for any similar condition, irrespective of the propelling power, and agrees with the formula $HP = \frac{W \times S \times F}{375}$, where $W =$ weight in tons, $S =$ speed in miles per hour and $F =$ the friction resistance in pounds per ton. From this it is at once apparent that if the speed or friction changes, the horsepower input to drive the car also changes. As a matter of fact, the friction resistance changes with every change of speed, so that no predetermination of the mileage that a vehicle will run on one charge of the battery is possible unless we assume a fixed condition of speed, gear and road friction, which assumption would be ridiculous.

The variation in friction resistance due to speed will be seen upon examination of the accompanying curve, which is plotted from data obtained by the writer from a test made upon an electrically propelled car over a boulevard road. This car was equipped with solid-rubber tires, and has a variable friction resistance, including gears, track, etc., of from 17.3 pounds per ton at five miles per hour to 39.3 pounds at nineteen miles per hour, which is the maximum speed of the car.

Referring to the formula stated above for the horsepower required at various speeds, an example may be given as showing the effect of speed upon the energy consumed, while a given distance is being traveled. Assume a total weight of car of one ton, then at a speed of ten miles per hour we have from the curve a friction resistance of twenty-four pounds per ton. The horsepower at the armature-shaft coupling is, by the formula,

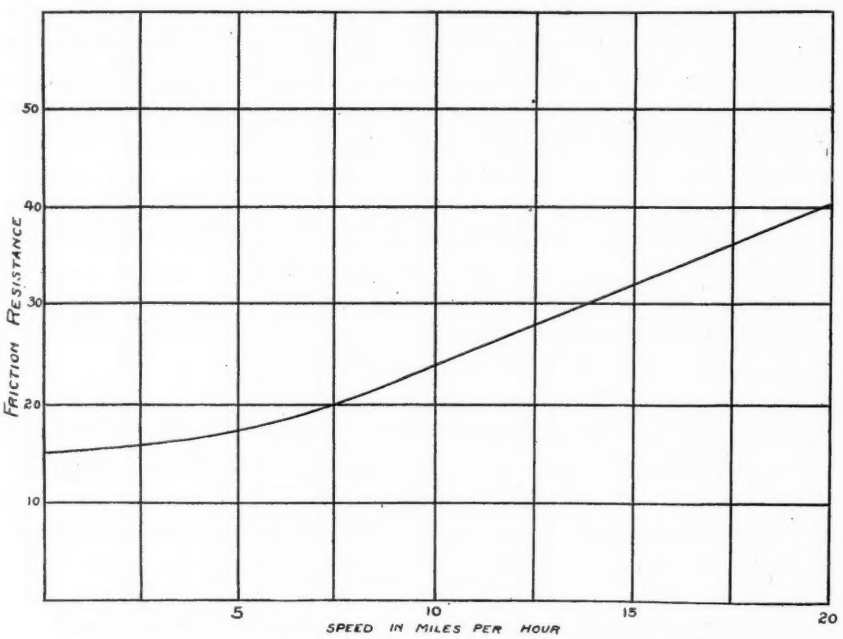
$$\frac{1 \times 10 \times 24}{375} = 0.64.$$

At the higher speed of nineteen miles per hour the friction is 39.3 pounds per ton and the horsepower at the armature-shaft coupling is

$$\frac{1 \times 19 \times 39.3}{375} = 1.99.$$

To travel a given distance, say, twenty-five miles, would require in the first case 2.5 hours, or $2.5 \times .64 = 1.6$ horsepower-hours, while in the second case, twenty-five miles would require only 1.3 hours, but calls for $1.3 \times 1.99 = 2.6$ horsepower-hours, showing at once that the energy input for the higher speed is sixty-two-and-one-half per cent greater.

It is apparent, therefore, that an unqualified statement that an electric car will travel a certain number of miles on one charge of its battery is misleading. Such statement should not and, in truth, cannot be broadly made, but must include at least the further statement that the road is level, that the operation of the car will not exceed a certain speed and should further be qualified, in giving the radius of action under these conditions, by stating the miles "approximately" or well within the possible maximum. For it is obvious that, quite apart from the fact that the battery capacity will be less due to increased rate of discharge at the higher speed, the car will travel further at a slower speed because it takes less energy per mile to do so and because of the fact that such energy is being taken from a stored source.



FRICTIONAL RESISTANCE ENCOUNTERED AT VARIOUS SPEEDS.

Another and quite as important a factor in determining the mileage radius of an electric vehicle is the efficiency of the battery at various rates of discharge.

The electric car above referred to, upon which a test was made, was equipped with forty cells and at the speeds taken above for comparison (namely, ten and nineteen miles per hour), required a current of 11.5 and forty-three amperes, respectively. Now the capacity of any storage battery, as is well known, is based upon the eight-hour rate of discharge and for comparison with other rates of

discharge, the eight-hour rate is taken at 100 per cent. For the particular battery with which the car tested was equipped, 11.5 amperes (or the current taken at ten miles per hour) is found to be sixty-one per cent of the eight-hour rate and forty-three amperes, required for the speed of nineteen miles per hour, is 227.5 per cent of the eight-hour rate. In other words, the battery having a total capacity at the eight-hour rate of 151 ampere-hours has, at the 11.5-ampere rate, a capacity of 187.5 ampere-hours, and at the forty-three-ampere rate a capacity of 109 ampere-hours. At the volts of discharge for each rate the battery capacity for the 11.5-ampere rate is therefore 14,800 watt-hours, and for the forty-three-ampere rate 7,350 watt-hours. The watt-hours per vehicle-mile from the above data of the test are ninety-eight at ten miles per hour and 179 at nineteen miles per hour. Therefore if the battery capacity at the 11.5-ampere rate is 14,800 watt-hours, as above, the car will travel $\frac{14,800}{98} = 151$ miles at ten miles per hour under ideal conditions, while at a speed of nineteen miles per hour it will travel only $\frac{7,350}{179} = 41$ miles. The rather extreme difference in the watt-hours per vehicle-mile, as found for this particular machine, was largely due to low-motor efficiency at the higher current rate, which, it was found, was caused by a poorly constructed armature, in which the effect of core lamination had been almost entirely nullified by filing out badly punched slots in the discs. If the motor efficiency at the lower speed had been maintained at the high speed the mileage at this high speed would, of course, have been considerably greater. The figures serve, however, to illustrate the point at issue, which is that mileage radius is determined by very many conditions, and the effect of all these conditions—speed, friction resistance, kind of tires, motor efficiency and battery efficiency—should be given to qualify any statement of the mileage radius of any electrically propelled vehicle.

There is, however, still another and important factor to be mentioned as affecting the total miles an electrically driven car will make on one discharge of the cells. In the foregoing it has been assumed that the car is started, accelerated to a given speed and run continuously at such speed upon a perfectly smooth and level road for the total miles it will go, and statements of mileage radius are usually based upon this assumption. This is not true in practice, particularly in city streets, where the electric vehicle finds its greatest sphere of usefulness. The car is constantly stopping or slowing down and again accelerating to speed, and with the type of motor usually employed this accelerating effort calls for a discharge rate from the battery of from two to three times the normal four-hour rate of discharge, so that during each period of acceleration the battery has an efficiency varying possibly from the one-hour to the four-hour rate.

The Faraday Society.

The forty-first ordinary meeting of the Faraday Society was held on Tuesday, February 9, 1909, at the Institution of Electrical Engineers, 92 Victoria Street, S. W., London, Dr. V. H. Veley in the chair.

Dr. S. Rideal read a paper entitled "Application of Electrolytic Chlorine to Sewage Purification and Deodorization by the 'Oxychloride' Process."

This paper contains an account of an elaborate investigation carried out by the author at Guildford on the use of hypochlorite solutions in sewage treatment. The experiments were made on a fairly large scale on the town sewage at the Corporation works. This when it emerges from the septic tank is dark colored, more or less fetid from the presence of sulphuretted hydrogen, and contains very large numbers of bacteria, some of which are capable of producing disease. By adding a small quantity of a chlorinous liquid odor is removed, and any nuisance arising from sewage distribution is completely avoided. But the most important feature is that the effluent is rendered harmless, the disease-producing organisms being destroyed. After the publication of the author's first experiments in 1904, the Royal Commission on Sewage Disposal visited Guildford and confirmed the results, further finding that the chlorine treatment did not hinder the subsequent purification in the bacterial coke filters. During 1907 and 1908 Dr. Rideal has continued the trials, and finds that the process actually aids the purification, first, by causing the filter-beds to mature more rapidly; secondly, by keeping the pipes free from fungous growths; thirdly, by the fact that the avoidance of clogging enables a finer filtering medium to be used, which gives better final effluents. The form of chlorine used was a hypochlorite solution prepared electrolytically. This method of sewage treatment has a great sphere of usefulness in preventing the pollution of rivers and in entirely removing aerial nuisance.

W. Pollard Digby hoped that much further information might be forthcoming concerning some of the more purely electrochemical details of the "oxychloride" process, such as the construction of the diaphragms, strengths of solutions, salt consumption, costs, and so on. He himself had found double diaphragms of considerable advantage.

Mr. Shenton pointed out that difficulties were likely to arise when storm waters vastly increased the volume of water to be sterilized, although this, of course, was only occasional. He thought that the prejudice many sanitary engineers felt against sterilization would gradually disappear when it was realized how economical and practical many of the processes really were. Not sufficient was generally known about sterilization.

Mr. Martin considered the storm difficulty more formidable than the last speaker had thought; to deal with twenty to fifty times the dry-weather flow required an enormous plant that must be ready to operate at any instant. The effect of chlorine in preventing the clogging of heads of pipes was an important feature in its favor.

A. B. Thomson stated it was difficult to give definite figures for costs, as these depended upon local charges for power and materials. He could not agree with Mr. Digby that distributing hypochlorite in carboys could not pay, seeing that electrolytic chlorine was a far better purifying and sterilizing agent than chloride of lime, and, moreover, left no lime in solution to clog filters and otherwise give trouble.

J. Fieldhouse said that an automatic valve for regulating the flow of hypochlorite from special storage tanks was used to admit of the necessary amount of sterilizer in time of storm.

Mr. Pollard took exception to the use of the word "oxychloride," which gave a wrong idea as to the fluid's constitution.

Dr. S. Rideal in the course of his reply referred to the uncertainty surrounding the constitution of the electrolytic fluid. It was usually supposed to consist of hypochlorite, but he had recently found that chlorites were present—ClO_2 ions. No chlorate was formed in the cold, either with or without a diaphragm.

BOOMING THE ELECTRIC VEHICLE IN NEW ENGLAND.

BY L. D. GIBBS.

Steps have just been taken at a Boston meeting of manufacturers, manufacturers' agents, battery manufacturers and representatives of the Edison Electric Illuminating Company of Boston to develop the business in electrically operated automobiles, trucks, delivery wagons, etc. W. H. Atkins, general superintendent of the Boston Edison Company, called the meeting for February 25 at the Boston Athletic Association club house, at which all the interests identified with the movement were represented.

Frank J. Stone, New England representative of the Electric Storage Battery Company, was chosen chairman of the meeting, and after the banquet an interesting and valuable discussion of the possibilities, not only of the vehicle but of the field to be developed, took place. In opening the discussion Mr. Stone said that the possible effects of such a getting together of the interested parties must result advantageously to the electric vehicle business as a whole. He pointed out that although New England has its well-built roadways, magnificent park systems and beautiful natural scenery—all accessible with the electric vehicle—the use of this machine has not been nearly so extensive as it will be.

He believed that unity in action between the interested parties would produce splendid results. The interests of the manufacturer and central station and the public are mutual. United effort will bring satisfactory results. Mr. Stone emphasized the necessity for good garage accommodations for electrics, widely distributed and widely advertised. There should also be systematic inspection of cars and batteries.

It is important, he said, that purchasers of electric vehicles be familiarized with the machines they use and that public garages know more about these machines. He said that in battery work he had found numerous cases where vehicles did not give the maximum service because they had not been given proper attention. Garage managers in the past have been backward and have been telling customers that the electric vehicle proposition did not warrant attention, but garages and dealers are waking up and are seeing through the now remarkable demand the possibilities of the business. Mr. Stone also spoke of cases where outrageous charges had been made—as high as $5 for a simple inspection of the battery.

He said that in several New England cities the electric vehicle was for a time in bad repute, but that a change in sentiment is now noticeable, due to the efforts made to secure better accommodations for cars. The progress has been slow, however, because of lack of united force. These conditions have made it easy to find comparisons between machines that were unfavorable to the electric vehicle. The backwardness in the development of the electric vehicle business has not been due to lack of mileage capacity. Great mileage is not required; the electric vehicle is not intended to compete with the gasoline machine in long and unusual trips. The electric is strictly for family, professional and commercial use in the city and its suburbs. For special work, however, "doing stunts," special arrangements might be made so that the electric machine would make as good a showing as the other makes.

Mr. Stone emphasized the keynote of the meeting, really the reason for its having been called, which was the importance of the organization of the various interests for co-operative work. He pointed out that the manufacturer, or his agent, would use the fact that there was such an organization to excellent advantage in negotiating sales. The organization can take steps to provide ample charging facilities, inspection for both public and private vehicles, competent vehicle and battery men, means for educational work, protection against exorbitant garage charges, overtaxation and too high insurance rates, and, in fact, cover the field in the way it should be.

It is proposed to arrange for talks and illustrated lectures before business men's associations and conventions in different cities; these lectures to cover the general field of the vehicle business, engineering, transportation, batteries, garages, etc. Efforts will also be made to bring the garage men together frequently for instruction in the care and operation of electric vehicles.

It was interesting to note at this meeting that points were brought out showing the great differences between electric and gasoline machines. The gasoline machine, much larger and more difficult to handle, is distinctively the machine for long trips; the electric car is the car for shopping, the theater, calling—in fact, takes the place of the carriage for ladies and family use. It is of special advantage to the business man running to and fro about the city, in and out through the traffic-crowded streets, making quick time, no noise, and requiring no chauffeur. It is a most valuable car for the physician. Ready on the instant and reliable in service, it can be depended upon absolutely to take the physician, day or night, in fair or bad weather, quickly to his destination.

Ladies get special pleasure in the use of the electric car because they can drive it themselves.

Stopping to make a call they can lock the door and leave the machine beside the curb. The same is true when on shopping trips, and in many cities it is customary to see long lines of electric vehicles beside the street curb in the vicinity of popular theaters where families or even ladies unattended have drawn up their machines, locked the doors and left them without fear of molestation.

Following the discussion committees were appointed to report plans for the organization and outline the work. Officers will be elected at the next meeting, which takes place in one month from the date of the first meeting. All of this work is in line with the pioneer effort of the Boston Edison Company several years ago, and much of the information gathered and advertising done at that time will be available for the newly formed association.

Among those present at the Boston meeting were the following: W. H. Atkins, general superintendent; L. R. Wallis, assistant to the superintendent; W. H. Francis, purchasing agent, and R. S. Hale, superintendent of sales departments, all of the Boston Edison Company; William P. Kennedy, chief engineer, Studebaker Company of New York; Alexander Churchward, General Electric Company; Col. E. W. M. Bailey, S. R. Bailey & Company; Day Baker, General Vehicle Company; E. D. Dodge, Dodge Motor Vehicle Company; Ferd F. French, French Carriage Company; Ira Miller, Babcock Couple Gear Company; E. A. Allen, Anderson Carriage Company; S. G. Thompson, Studebaker Bros. Company; A. F. Neale, Baker Motor Vehicle Company; J. H. MacAlman, Electric Vehicle Company; Mr. Church, Couple Gear Freight Wheel Company; C. H. Hile, J. H. Neal, of the *Electric Vehicle and Central Station,* and Frank J. Stone, Electric Storage Battery Company.

Programme of the Seventh International Chemical Congress.

The programme for the Seventh International Congress of Applied Chemistry which is to be held in London during the week ending June 2, has now been issued, and from the list of 106 papers promised for reading and discussion in the various sections into which the congress is divided we select the following as likely to be of special interest to our readers:

SECTION I. ANALYTICAL CHEMISTRY.

Henry Sand, "New Apparatus for the Electroanalytical Separation of Metals" (with demonstration).

Professor Coustan, "Analytical Methods of Fuel Testing."

SECTION II. INORGANIC CHEMISTRY AND THE ALLIED INDUSTRIES.

M. Fery, "The Calorific Power and Pyrometry of Gas."

M. Verneuil, "The Artificial Production of Rubies."

M. Lebeau, "The Poisonous Gases Liberated by Ferrosilicon."

M. Abraham, "The Industrial Production of Ozone."

Dr. B. Szilard, "Radioactive Elements."

SECTION III. METALLURGY AND MINING.

Dr. L. Guillet will join in discussions on (a) "Metallography," (b) "Thermal Treatments and Welding," and will read reports on (a) "Electrometallurgy in France," (b) "Treatment of Metallurgical Products," and (c) "Special Steels."

Dr. T. K. Rose, "Electrolytic Refining of Gold."

Dr. Hans Goldschmidt, "New Developments of the Thermal Process."

Professor Galloway, (1) "Changes in the Quality of Coal," (2) "Coal Dust."

SECTION X. ELECTROCHEMISTRY AND PHYSICAL CHEMISTRY.

Professor Rosenheim, "The Electroreduction of Tungstic Acid."

M. Girntz, "The Preparation and Properties of the Alkaline Earth Metals in the Pure State."

M. Gin, (1) "Electrometallurgical Treatment of the Minerals Containing Tungsten, Molybdenum and Vanadium," (2) "Electrometallurgical Applications of Silicothermæ."

M. Urbain, "Separation of the Pure Earths."

MM. Sabatier and Mailhe, "Applications of Catalytic Methods by Aid of Finely Divided Metals."

The number of papers accepted for reading and discussion will be largely increased between the present date and that of the opening of the congress, and those of our readers who wish to present papers should communicate with the members of the various sectional committees in this country. The following are the names of the committees of Sections III and X:

Section III—Metallurgy and Mining.—John Hays Hammond, New York; F. P. Dewey, Washington; H. O. Hofman, Boston, Mass.; N. W. Lord, Columbus, Ohio; I. W. Richards, Bethlehem, Pa.; C. H. Richards, Boston, Mass.; A. Sauvene, Cambridge, Mass.; T. D. West, Sharpsville, Pa.

Section X — Electrochemistry and Physical Chemistry.—W. D. Bancroft, Ithaca, N. Y.; C. A. Doremus, New York; F. A. J. Fitzgerald, Niagara Falls; L. Kahlenberg, Madison, Wis.; E. R. Taylor, Penn Yan, N. Y.; W. R. Whitney, Schenectady, N. Y.

The membership of the congress costs $5, and only those who have become members are entitled to read papers or to join in the discussions. The official languages of the congress will be English, French, German and Italian, but the minutes of the proceedings will be written in English. The subscription for ladies who accompany members is $3.75. The address of the London organizing secretary is 10 Cromwell Crescent, London, S. W.

Public Utilities Bills in the Indiana Legislature.

The Indiana Legislature advanced several bills, passed one or two and killed others relating to traction lines, telephones, etc. The bill permitting the charge of an extra fare on interurban and steam roads when tickets are not procured by the passenger, passed. There was a demand for this measure from conductors, who claimed that the rebate checks necessitated much labor. An effort was made to except interurban roads, but this was not agreed to. The bill to compel interurban companies to refund half the fare when seats are not supplied, was killed. The measure was pronounced impractical, unfair and useless. The bill requiring all railroads to stop their trains at state lines long enough to enable passengers to purchase tickets, which must be kept on sale at the two-cent rate, was likewise killed. The purpose was to avoid the payment of three cents per mile for interstate travel. A bill permitting the interchange of traffic between electric and steam railroads was passed, as was also a bill to compel common councils in cities of the fifth class to advertise for bids for lighting and heating contracts. The bill permitting telephone companies organized under the Indiana law to merge, or one company to acquire another or more, has passed the House and advanced in the Senate. This bill has aroused great interest and considerable opposition lest it be a step toward combination and monopoly. A bill has been introduced which has aroused equal interest and even greater opposition on the part of telephone men because it compels telephone companies to make physical connection and exchange calls where operating in the same territory. S.

New York Section, Illuminating Engineering Society.

The next regular meeting of the New York Section of the Illuminating Engineering Society will be held in the Engineering Societies Building, 29 West Thirty-ninth Street, New York city, on Thursday, March 18. The date is one week later than the usual time set apart for the meeting.

Two papers will be presented, namely, "The Mathematical Theory of Finite-Surface Light Sources," by Bassett Jones, Jr., and "Illuminating the Editorial Offices of the New York World," by Albert J. Marshall. These papers treat of both the theoretical and practical sides of the subject, and will be taken up and discussed. Advance copies of the papers will be sent upon request.

Cost of Pole Supplies.

The chief consumers of poles for the construction of wire lines are electric light, railway and power companies. Next in order are telegraph and telephone companies, while railroads are the third in rank. The forest service of the United States has compiled figures of expenses of these various classes of companies for two years covering this item. In the table below are given the total costs for each class of companies and the average cost per pole. The aggregate outlay in 1907 was $10,229,642, or an average of $2.92 a pole. This was distributed as follows:

	—Cost, 1907— Total.	Av.	—Cost, 1906— Total.	Av.
Tel. and telg. cos.	$3,977,019	$1.72	$5,234,949	$2.19
Steam railroads...	828,776	2.81	585,827	2.30
Electric rwy., light, power, etc	5,423,847	6.02	3,650,395	3.95
Total and aver.	$10,229,642	$2.92	$9,471,171	$2.65

ALTERNATING CURRENTS AND THEIR APPLICATIONS.

BY EDSON R. WOLCOTT.

CHAPTER VI. (PART I.)—LIGHTING.

METHODS.

The fact that manifestations of the electric current can be utilized as illuminants has been known for over a hundred

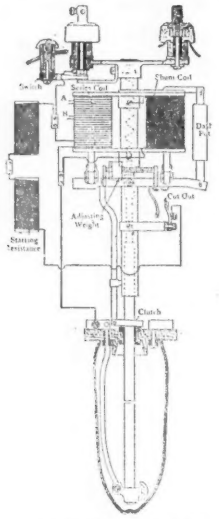


FIG. 118.—CONNECTIONS OF SERIES ALTERNATING-CURRENT ARC LAMP.

years, but the practical application of electricity to this purpose dates back only about a quarter of a century.

There are three general methods of applying the electric current to illumination:

1. Arcs.
2. Incandescent filaments.

FIG. 119.—MECHANISM OF SERIES ALTERNATING-CURRENT ARC LAMP.

3. Tubes containing gases or vapors at less than atmospheric pressure.

USE OF ALTERNATING CURRENTS.

In general, alternating currents are used in all three methods. In some cases, notably the first, their application is not always as efficient as the use of direct currents, particularly with certain types of flaming arcs.

There are some incandescent filaments that can be used to even better advantage on an alternating-current system; for example, the non-metallic filaments or glowers, such as are used in the Nernst lamp. On the other hand, some of the metallic filaments, such as tantalum, show longer life in direct-current service.

In all cases, however, alternating currents play a considerable part because of their advantages in distribution, although it is sometimes preferable to combine a system of alternating-current generation and distribution with rectifying apparatus for use with direct-current series arc lamps.

INCANDESCENT LAMPS.

In recent years many improvements have been introduced in the incandescent-lamp field. In fact, before one type of lamp became established, another and more efficient one appeared. Quite recently the advance has been particularly rapid along the line of metallic filaments for use in incandescent lamps. Undoubtedly there will be many more improvements in the near future, as there is still considerable energy wasted as heat in the transformation of electrical energy into light.

ARC LAMPS.

When an electric discharge takes place between conducting electrodes in air the terminals are heated to a very high temperature, in fact being vaporized, the heated vapor forming the conducting path across the air gap. When carbon electrodes are used the discharge takes place through the vaporized carbon and the electrodes are gradually consumed. To compensate for this, some method of automatically adjusting the electrodes is necessary. In general this is not difficult. The electrodes can be so arranged that they are in contact when the current is turned off. Then when the circuit is closed the current passes through a solenoid in series with the electrodes. The upper electrode is mechanically connected to the solenoid in such a way that it is lifted as the current begins to flow. Of course if it is lifted too high the arc breaks and the electrode falls, again making contact, and so on. In practice, however, it is somewhat difficult to get that length of the arc which gives the best illumination and yet is not breaking continuously. A method of doing this in an alternating-current series arc lamp is illustrated in Fig. 118.

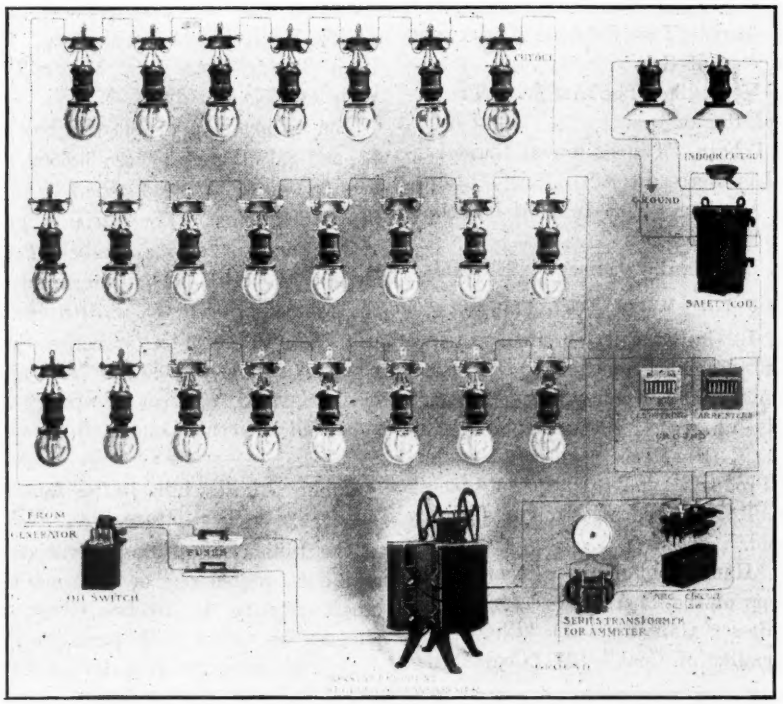


FIG. 120.—DIAGRAMMATIC SKETCH OF SERIES ALTERNATING-CURRENT ARC-LAMP SYSTEM.

OPERATION OF A SERIES ARC LAMP.

In the series system of connecting arc lamps it is necessary that the arc be automatically thrown out of circuit when not in use. A method of doing this is also shown in Fig. 118. As the switch is thrown on, the series coil is energized and the clutch lifted, so that the carbons

are separated and an arc formed. If lifted too far the resistance of the arc is increased and the higher voltage across the lamp deflects more current through the shunt coil which acts differentially on the clutch, and the carbon is lowered. If a carbon should burn out the clutch would be lowered and the cut-out switch

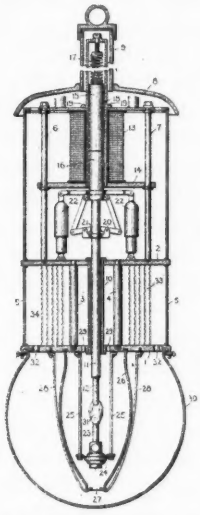


FIG. 121.—VENTILATION OF VAPOR PRODUCTS OF FLAMING ARC LAMP.

closed, so that the current would be flowing only through the starting resistance. This latter is also of service when the arc is started, as it prevents a sudden rush of current at the moment of closing the circuit.

Fig 119 shows the appearance and arrangement of the lamp parts just described.

Arc lamps operate at about seventy volts pressure and with a current varying from three to eight amperes, depending on the size of the lamp. For the successful operation of arc lamps the current should vary as little as possible. The usual arrangement of the lamps is to connect them in series with each other and with a constant-current transformer such as has already been explained.

Fig. 120 shows a method of connecting both exterior and interior alternating-current arc lamps to a constant-current transformer.

THE ENCLOSED ARC.

During the past decade the enclosed arc has almost displaced the open arc as used for lighting purposes. Although the efficiency of the enclosed arc is not as great, still the illumination is more diffused, the arc is steadier and the cost of maintenance is decreased. The arc illustrated in Fig. 118 is of the enclosed type. When the arc is enclosed in a small globe so that it is practically air-tight the combustion of the carbons takes place at a much slower rate.

THE FLAMING ARC.

When carbon is impregnated with salts of calcium, barium, strontium, magnesium or the like, a new vapor, that of the salt or metal, is added to the vapor-

FIG. 122.—METALLIC FLAME ARC LAMP.

ized carbon of the ordinary arc, the conductivity is increased, and the volume of incandescent vapor becomes larger, resembling a flame. In this way the source of light becomes of greater extent.

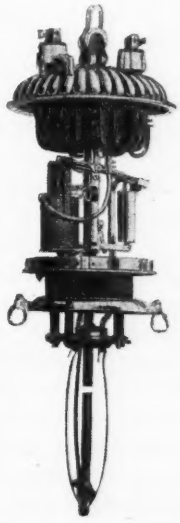


FIG. 124.—CONSTANT-VOLTAGE ALTERNATING-CURRENT ARC LAMP MECHANISM.

The color of the flaming arc varies with the different salts; calcium imparts a yellow light which is very efficient, strontium adds a red tinge to the arc and is not as luminous. A colored arc, of course, does not produce proper colorations in objects upon which the light falls, so that efficiency is sometimes sacrificed in order to produce a white flaming arc.

Flaming arcs are probably used to a greater extent with direct than with alternating currents, although they may be employed on either service. The flaming arc is sometimes unsteady and liable to

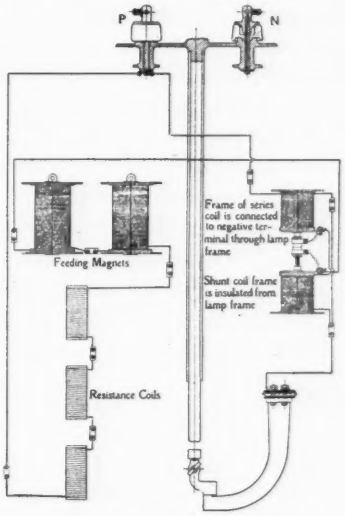

P
N
Feeding Magnets
Frame of series coil is connected to negative terminal through lamp frame
Shunt coil frame is insulated from lamp frame
Resistance Coils

DIAGRAM OF INTERNAL CONNECTIONS

FIG. 123.—DIAGRAM OF CONNECTIONS OF METALLIC FLAME ARC LAMP.

go out if not properly protected from air currents.

The salts with which the carbons are impregnated are deposited by the arc on the cooler surfaces surrounding it. This, of course, aids in reflection, since the deposit is white, but when deposited on the globes also decreases their transparency so that means for eliminating the vapor are found advantageous. A recently patented method of doing this is shown in Fig. 121. The air within the inner enclosure 26 is carried upward by the heat developed in the arc and takes with it the fumes or vapor coming from the arc through the openings 29 into the chamber 34, where the material is deposited. The air then passes through the openings 32 into the outer vessel 30 and up through the opening 27 into the inner chamber again.

METALLIC FLAME ARC LAMPS.

Although metallic flame arc lamps are not used directly on alternating-current circuits, they are often employed in connection with mercury-arc rectifiers of alternating currents, and a brief description of them therefore may not be out of place.

In these lamps the use of carbon electrodes has been abandoned. The upper or negative electrode consists of a mixture of powdered metallic oxides encased in

a light iron tube, the lower end being sealed by the arc. The lower or positive electrode consists of a composite metallic button designed to produce a slag or cinder which will be a conductor when either hot or cold. An illustration of this type of lamp is shown in Fig. 122, and a diagrammatical illustration of the connections is disclosed in Fig 123.

The advantages claimed for this lamp are that it has a lower consumption of energy, a greater range of voltage, more brilliant illumination and longer life of electrodes than the enclosed carbon arc.

ARC LAMPS IN MULTIPLE.

The application of the electric arc is very general. It is used on both direct and alternating-current systems and is connected both in series and in multiple, that is, for use either with constant current or constant voltage.

The mechanism of a lamp designed for use on constant-voltage circuits is illustrated in Fig. 124. At the top is an autotransformer for adjusting the voltage across the arc to the proper value. Connections to taps of the coil are made by an adjustable contact. Current adjustment is attained by the taps on the series magnet coil.

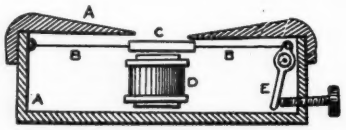
Acoustic Method of Tuning Wireless Receivers.

Some time ago, M. Blondel proposed a method of tuning for wireless telegraphy in which, instead of using electrical tuning or resonance, he suggested the employment of acoustic tuning, receiving the signals by ear in a tuned telephone receiver which acts as a resonator and will respond to only one rate of vibration. Signals sent from a wireless station having a given vibration period will thus be received, but no others. The fundamental part of the system is the tuned telephone, or what is termed the "monotelephone."

Such an instrument has already been used by M. Mercadier in his method of multiplex telegraphy. It consists of a telephone receiver in which a vibrating disc is supported at three points around the circle, representing a nodal or non-vibrating part. Mounted thus, with an electromagnet behind it, the disc can vibrate only for a given frequency of current in the magnet; at any other frequency its action is very slight. But when the magnet is energized, say, 100 periods per second, the disc responds, forming a resonator for this frequency. M. Mercadier employs a series of monotelephones tuned to fifty, 100 and 150 vibrations.

According to M. Blondel's idea, the transmitting station would send out a signal having a wave frequency of, for instance, 100 impulses per second. The receiving station using monotelephones tuned to the same frequency would then perceive only the signals sent from its respective transmitting station, exclusive of all others. The monotelephone is operated by any kind of detector or coherer in general use for telephone receiving. As in M. Mercadier's system, the monotelephone can also be made to operate a relay of suitable design, making the movement of the diaphragm establish a contact. In this way the two stations are tuned together by a purely acoustic method which is quite distinct from the scheme of electrical tuning generally in use.

In the present condition of the art, however, M. Blondel's plan cannot be put



CROSS-SECTIONAL SKETCH OF ABRAHAM MONOTELEPHONE.
AA, Case. D, Magnet.
BB, Wire. E, Tension Device.

into practice except in very high-powered stations using, say, 500 horsepower, such as the Glace Bay or Cliffden plants, since the vibrating method employed decreases the power of the signals, limiting the range to shorter distances than usual. A form of monotelephone more sensitive than the present one would increase the range of receiving.

M. Abraham, a Paris physicist, to increase the range of action, proposes to construct a sensitive monotelephone in the following manner: Referring to the diagram, the new device is seen to be a modified telephone receiver. At the same time the monotelephone can be adjusted for different frequencies. Leaving the electromagnet in place, the telephone diaphragm is replaced by another in the shape of a soft-iron disc which has a slightly larger diameter than the magnet core. The disc or armature is held by two wires of steel or other metal, which are attached at one end to the case and at the other to a stretching device, consisting of a pivoted lever and a thumbscrew. The wires can thus be tightened to any desired degree of tension from the outside of the case. Such a monotelephone is found to respond very distinctly to vibrations of a certain frequency, emitting a musical note corresponding to this period. The superiority of this design over the usual monotelephone lies in the fact that the functions of the telephone diaphragm are better distributed than in the ordinary instrument, since one portion acts as an armature and a second part furnishes the elasticity. By this means a heavier disc or armature can be used than where this part needs to be held fixed. On the other hand, the suspension wires are very light. Owing to their construction, it is possible to make the characteristic vibration period of the device to be almost free from harmonics. It is found that the new monotelephone will cover a wide range, more than a single octave, so that there is a greater range in the choice of the vibrations to be used.

A New Source of Hydrogen Gas for Balloons and Airships.

The electrolytic process of alkali manufacture, in which an aqueous solution of the alkali metal chlorides is split up by the electric current into its component elements—sodium (or potassium) and chlorine gas—produces large volumes of hydrogen gas, due to the reaction between the alkali metal and the water. In the majority of instances this gas has been allowed to escape from the cells into the atmosphere, although in one or two of the continental electrolytic alkali works a portion of the gas has been collected and compressed into large gas cylinders for sale. According to a recent issue of the *Elektrochemische Zeitschrift,* the parent electrolytic alkali company in Europe, the Chemische Fabrik Griesheim Elektron, is about to collect and store the gas on a large scale. Plans for two large gasometers have been drawn up, and the erection of the first of these, with a capacity of 1,500 cubic metres (53,000 cubic feet), is to be proceeded with at once, while a second larger gasometer, with a capacity of 5,000 cubic metres (176,000 cubic feet), will be erected, if the demand for the gas warrants such an extension. The two gasometers are to be erected on land adjacent to the company's electrolytic alkali works at Griesheim, near Frankfort, and it will be interesting to see what result attends this new venture of the Griesheim company. The success attending Count Zeppelin's recent voyages in the air, has aroused great interest in airship construction in Germany, and it is quite possible that the erection of large hydrogen gasometers at Griesheim may be followed by others elsewhere.

The Loetschberg Tunnel Electric Railroad.

BY C. L. DURAND.

Switzerland is one of the countries of the Continent in which the development of electric railroading has reached the greatest progress within the last few years. This is only natural since all the coal which is used in that country must be imported and, therefore, comes at a relatively high price, and on the other hand the sources of hydraulic power are abundant. Most of the existing railroad lines in Switzerland are controlled by the state and are known as the Swiss Federal Railroad. There is a move toward the adoption of electric traction on a large scale on the Federal roads going on at present, and among the important sections of railroad which are now operated entirely by electric locomotives, at least as regards the passenger traffic, are the Simplon tunnel section and the Seebach-Wettingen line, this latter having had a regular service on the electric system for some time past.

In the present article there will be described an electric railroad enterprise which will be by far the most important in Switzerland, this being the new railroad known as the Bernese Oberland line. It does not form a part of the Federal railroad system, but is constructed by a private company whose headquarters are located at Berne. The new railroad is worthy of note for several reasons, one of these being that it is the longest in the county to be operated as a standard-gauge, double-track railroad by the use of electric locomotives and the regular type of railroad cars. Along its course it passes through the Loetschberg tunnel, which is by far the most important tunnel enterprise to be carried on at present in Europe, which will be seen from the fact that it is eight-and-one-half miles long and therefore compares in length with the Simplon tunnel, which is about twelve miles in length. However, the new tunnel, being laid out for double track, is much larger in section than the Simplon, which contains but a single track. The entire cost of the new railroad enterprise is $15,000,000, including the tunnel, which figures for half that cost. Another point to be noted is that the new electric railroad will connect with the Simplon line and, in fact, it

MAP OF SOUTH CENTRAL SWITZERLAND, SHOWING THE COURSE OF THE LOETSCHBERG TUNNEL.

CONSTRUCTION PLANT AT THE SOUTH END OF THE LOETSCHBERG TUNNEL ON THE BERNESE OBERLAND RAILROAD, FROM BERNE, SWITZERLAND, TO MILAN, ITALY.

forms the northern continuation of the Simplon route, so that the electric trains will pass from one to the other line.

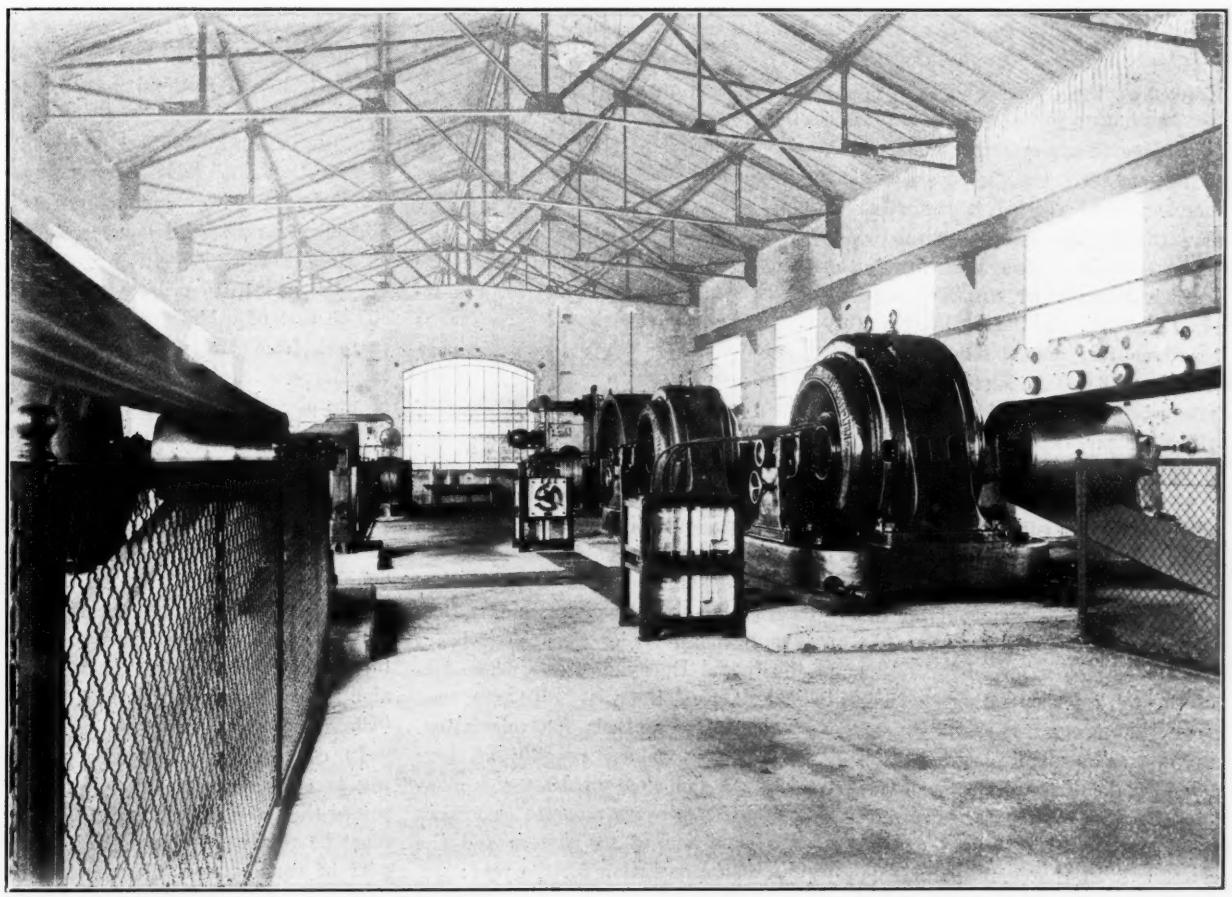
While the outlay required for such a difficult piece of work as the building of the present railroad was an important one, it is justified by the great advantages which will be secured from it in the future. As will be observed on the map, Berne is the principal railroad centre of the northern part of the county, and many of the lines coming from France and Germany converge at this point. As Berne lies at a short distance in a direct line from the Simplon, it would be an easy matter to reach the Simplon tunnel and to proceed thence to Milan and the north of Italy were it not for the fact that the great mountain chain of the Bernese Oberland lies in the way. In consequence it was impossible to reach the Simplon except by taking a very roundabout course by way of Lausanne and St. Maurice. By the construction of the Bernese Alps railroad there will now be a direct connection between the north of Switzerland and Italy, and it is expected that the new route will secure a large part of the international traffic, especially having been heretofore an impassable barrier.

SOUTH PORTAL OF THE LOETSCHBERG TUNNEL, UNDER CONSTRUCTION.

The present line starts from Frutigen, which is the terminus of the short railroad section owned by the same company, and it proceeds southward through the mountain region of the Bernese Oberland, mounting up the steep valley of the Kander in a winding course. At a distance of 8.7 miles it reaches the locality of Kandersteg, where the Loetschberg tunnel commences. The tunnel is run in the side of the mountain range, which reaches a high altitude and contains many peaks covered with snow and glaciers. The mouth of the tunnel lies at a very high point, this being nearly 4,000 feet above sea-level, and 1,480 feet above the starting point of the line. After a passage of 8.5 miles the tunnel emerges at the other side of the mountain range at the locality of Goppenstein. From this point the railroad follows a cutting in the mountain side and descends for a distance of 17.6 miles, where it reaches the level of the Rhone valley and makes connection with the north end of the Simplon electric line.

The railroad company is now taking measures toward providing the electrical equipment of the line, and for this purpose it proposes to adopt the electric system on the short section of line running from Spiez, on the Lake of Thun, to Frutigen. This will be done in order to make trials of the electric locomotives and the rest of the outfit, and it is intended to use a high tension on the locomotives, taking into account the very successful results which have been obtained on the Seebach-Wettingen line by the Oerlikon firm in concert with the Siemens-Schuckert company with heavy locomotives on the single-phase system.

The locomotives for the Bernese Oberland line will be designed to take a 250-ton train upon a 2.7 per cent grade at a speed of twenty-five miles an hour, or a 300-ton train at twenty miles an hour. The locomotives are to be equipped in all probability with single-phase commutator motors, working at a frequency of fifteen cycles, and they will have a capacity of 1,200 to 1,500 horsepower. The railroad company will devote the sum of $200,000 for equipping the trial section of the line on this plan.



COMPRESSOR ROOM IN THE LOETSCHBERG TUNNEL PLANT.

This electric railroad line will have a total length of fifty-two miles, counting the section which is already built between Spiez and Frutigen, which it is proposed to equip electrically during the time that the new part of the line is being constructed. The new portion of the line is about thirty-five miles long, including the tunnel. It was decided to build the electric line in double-track, standard gauge throughout the whole of its length. The tunnel has a circular-arched form and is 19.8 feet in height above rail level, with the circular portion having a 13.2-foot radius. The total width of the section is 26.4 feet. Thus it will be seen that the construction of the tunnel will involve considerably more work per running mile of length under the ordinary conditions than was taken for the Simplon tunnel, as the latter is laid out as a single-track tunnel and accordingly is much narrower. As the total cost of building the tunnel and the railroad track within the same is $7,500,000, outside of the electric equipment of the track, this amounts to about $900,000 per mile for the tunnel section alone.

At either end of the tunnel there is erected a large plant which is needed for the drilling and the construction work, upon which there are about 2,000 men employed at present. The accompanying views show the plant located at the south end of the tunnel at Goppenstein; this plant consists of a considerable number of large buildings. All the power needed in the machine shops, compressor room, blast-fan plant, etc., is obtained from a distant hydroelectric plant, and all the machines are run by electric motors.

In one of the illustrations will be seen a view of the main compressor room of the plant. It contains four sets of electric motors and air compressors, which are used to supply the compressed air for operating the rock drills in the tunnel. As these drills require compressed air at a comparatively low pressure of ten atmospheres, there are installed two compressors in the plant which deliver air at this pressure. On the contrary, for use on the compressed-air locomotives of the tunnel, of which there are a number in use, air at a high pressure of 120 atmospheres is needed; a second group of compressors is accordingly installed for this purpose. Of the first-mentioned compressors there are two in use in the plant, and these are driven by belt from the motors which will be noticed on the right-hand side of the room, each of these motors being rated at 200 horsepower. The second group of compressors is operated by two motors of larger capacity, which are placed in a corresponding position on the left-hand side of the station. These motors are of 300 horsepower and are likewise belted to the corresponding compressors. All these motors have been furnished by the Alioth firm, of

Basle, Switzerland, and they are designed to run at 485 revolutions per minute on three-phase current, at fifty cycles and 500 volts.

Current is obtained for the present plant from two different hydraulic plants, which use the power of the Lonza stream. These turbine stations were erected for the purpose of supplying current for several large carbide plants which are now running very successfully in the region of the Rhone Valley. One of these carbide works is located at Gampel, near the Swiss Federal Railroad. Beside the carbide plant is installed a turbine station, which takes the water supply from a point higher up the stream and thus secures a 330-foot head of water. The plant located at Gampel is thus able to furnish upward of 4,000 horsepower, a considerable part of which is used for the carbide furnaces. In parallel with the Gampel station is a second hydraulic plant, which lies further up the Lonza River at Klosterli, in the rocky gorge through which this torrent flows, and it produces about 6,000 horsepower. This plant uses a 590-foot head of water. Both these turbine plants are operated in parallel upon the overhead line, which is worked at 5,000 volts.

A separate line is run from the pole line to the upper end of the valley, where the plant of the Loetschberg tunnel is located, in order to furnish current for the motors just mentioned and also for a number of other motors placed in various parts of the work for operating the machine tools, blowers for the tunnel, etc. A bank of transformers placed in the station lowers the three-phase 5,000-volt current of the line to the standard voltage of 500 volts, which is used on the motor circuits. In the compressor room is mounted a switchboard containing four marble panels, which are used for the different circuits of the station. In addition to this, each of the principal motors of the plant has mounted beside it a frame containing a rheostat for regulating the voltage of the motor, as will be observed in the illustration.

Electric Snow Melters Clear City Streets.

Electric snow melters are being used to clear the streets in the city of Berlin, Germany. The first experimental apparatus is reported to have shown an operation less than half as expensive as shoveling the snow and hauling it away.

Electrification of German Railroads.

For several years past German engineers have been actively engaged in the preliminary studies for an ultimate change to electricity as the motive power in ordinary railway transportation of passengers and freight. The decisive experiments in 1903, conducted by the Prussian railway authorities in connection with the General Electrical Company, on the line between Niederschönweide and Spindlersfeld, resulted in the design of the proper motor to use effectively the alternating current.

Since then no material advance has been made from the mechanical standpoint, nor has much been required of the electrical inventor. The new motors have rendered admirable service when utilized for urban and suburban traffic, and when applied on short lines. It is now a purely economic question whether the time has arrived to discard the steam locomotive after its eighty years of service, and replace it by the electrical locomotive as sole motive power for extensive railway systems.

The results of an exhaustive study of the subject, by Ph. Pforr, a prominent German engineer, may be of timely interest, and they are herewith briefly summarized by Consul Thomas H. Norton, of Chemnitz, Germany.

The study embraces the proposed electrification of the Prussian state railway system, which includes also the railways of the Grand Duchy of Hesse. The statistical data of the year 1904 are used throughout as a basis for calculation. The dollar is valued roughly at four marks. At the close of 1904 the manager of these railways reported as follows on the condition of the system and the results of the operation for the year:

Capital, $2,250,000,000. Length of single track, 12,785 miles; length of double track, 8,231 miles; a total length of 21,016 miles. Rolling stock, 14,770 locomotives, value $167,000,000; 27,367 passenger cars, value $82,500,000; 313,909 freight cars, value $220,750,000. Total transportation, 83,200,000,000 mile-tons (short tons), including 880,000,000 mile-tons, transportation of coal used by locomotives.

Expenditures.—Management, $12,859,000; station service, conductors, brakemen, $57,451,000. Maintenance and guarding of road: Wages, $21,688,000; material, $32,324,000. Motive power maintenance and renewal of rolling stock: Wages, $38,213,000; construction material, $9,519,000; renewal of locomotives, $7,794,000; renewal of cars, $8,308,000; coal for locomotives, $18,789,000; other outlays, $13,398,000. Miscellaneous expenses, $21,453,000; a grand total of $241,796,000.

Receipts.—Passenger and express, $110,253,000; freight, $268,926,000; divers, $25,304,000; a total of $404,483,000.

Proposing that current be transmitted at 50,000 volts, and that this be lowered to 15,000 volts at the conductors which supply the locomotives, and assuming that the cost of transformers per mile is $1,436 for double-track lines, and $862 for single-track lines, the total cost for transformers and accessories on the entire system, as detailed, would be about $25,000,000.

Overhead wire conductors costing $3,830 per mile of single track, would amount to $167,500,000 for the entire network of 21,016 miles of single track.

The cost of cables for distributing the current from the power houses to the transformers depends upon the location of the plants. Assuming distances apart of 125 miles, the entire system would require thirty generating plants. Upon this basis there would be an average cost per mile, for distributing cables, of $1,530 on single-track lines, and of $2,490 on double-track lines. The entire equipment would involve an outlay of $42,500,000. These three items constitute a total investment for permanent equipment along existing railway lines of $234,500,000.

In calculating the expense of changing to electric locomotives, it is not assumed that each existing steam locomotive must be replaced by an electric counterpart of equal power. Much time is required in the case of the current types of locomotives for a variety of operations, which disappear completely when electricity is employed. These operations are taking on water, heating up the boiler and changing direction on the turntable. Evidently fewer electric locomotives are required to accomplish the same amount of work.

On the entire system in question, during 1904, 31,376 men were employed in locomotive service. As each man has one day of rest every two weeks, the number would suffice to man simultaneously 11,500 locomotives, assuming that 3,000 have double crews. During this year 14,770 locomotives were in use. As the

average daily service of a locomotive is twelve-and-eight-tenths hours, and four hours are consumed in the cleaning, heating, etc., but fifty-four per cent of the total number of locomotives are simultaneously engaged in moving trains.

This percentage gives a basis for calculating the required number of electric locomotives. Allowing sixteen per cent for the average number of locomotives temporarily withdrawn from service for repairs, it would be necessary to replace but sixty-four per cent of the present stock by electric locomotives.

Steam locomotives cost about $0.1186 per pound, as compared with $0.1834 for the electric competitor. The latter is, however, relatively much lighter. An electric freight locomotive of 600 horsepower weighs 46.3 short tons (92,593 pounds). The current types of locomotives of the same power weigh 62.7 short tons (125,433 pounds), empty, and 83.75 tons when charged with water, etc.

On this basis the entire railway system would require an outlay of $133,750,000 for electric locomotives to replace the present supply, which cost $167,000,000. In order to eliminate possible cause of error, the expense of the new equipment is placed at $152,500,000.

Assuming that the steam locomotives now in use could be diverted without loss to other lines, or be continued in service during a gradual electrification until worn out, there would be a saving on this account of $14,500,000.

No estimates are prepared for generating stations, as it is simpler to consider the normal cost of the electric current as now furnished throughout Germany. It is assumed, also, that electricity could be advantageously supplied by private parties. At present electric current, when yielding four per cent on the investment, costs 0.833 cent per kilowatt-hour.

Turning to the cost of maintenance and operation, it is estimated that no material changes would be involved in the outlay for general supervision, station management, and train crews. A decided increase in expenditure is required, however, for the guarding and maintenance of the electric conductors and transformers.

For maintenance and repairs of cables and wire conductors an annual expense of two per cent on the original cost is to be expected, or $4,250,000. For the transformers these charges amount to five per cent, or $1,250,000.

Per contra, material economies on current sources of expense are to be expected. These result from the elimination of all existing outlay in connection with the supply of water and coal to locomotives. Diminished cost of maintenance for tunnels, stations and engine sheds come also into consideration. All told, these economies are estimated at $1,250,000 per annum. The total increase in cost of maintenance would hence be $4,250,000.

Quite different are the figures showing the cost of running trains and maintaining the rolling stock in good condition. In the case of electric locomotives, thirty-one per cent of the cost of labor is eliminated. Of the locomotive crews, numbering 31,276 men, three-eighths are engineers and five-eighths are firemen. Engineers earn annually $675, firemen $412. The total annual earnings of this staff are $15,950,000. The saving of thirty-one per cent would reach $5,000,000 per annum.

A still more important economy is assumed from the fact that ordinarily but a single man is required to guide an electric locomotive. The services of all employes now occupied as firemen become entirely superfluous. This involves an additional saving of $5,225,000. It is planned that the conductor of a train shall normally be stationed on the locomotive, and that he shall be prepared to meet any exigency arising from an accident to the engineer, or other unforeseen emergency.

The cost of maintaining electric rolling stock is notably less than in the case of steam engines, and is estimated as at least twenty per cent below the latter's requirements. At present the item is $10,500,000. Here there would be an economy of at least $2,000,000 per annum.

The annual coal bill of the Prussian railway system is $26,000,000. Of this sum, $18,789,000 represents the cost of the coal at the mines; the remainder is the expense attendant upon the transportation and storage of the fuel. In place of the coal bill comes the cost of the electric current. The present railway system would require annually 3,481,000,000 kilowatt-hours. At the current rate of 0.833 cent, this represents an outlay of $29,000,000.

The present annual expenditures of $13,398,000 for miscellaneous items, includes the following: Coal for stations, etc., $1,850,000; water, gas and electricity, $2,600,000; oil, cleaning waste, etc., $5,100,000. It is conservatively estimated that at least $4,750,000 can be saved on these items.

On minor accounts, machine cleaners, draft horses, losses by fires in forests from sparks, etc., a further economy of $1,750,000 should be attained.

On balancing the foregoing savings and additional outlays incident to the change to electricity as a motive power on the Prussian system, it is found that the total annual economy in the charges for maintenance and exploitation to be attained is $11,750,000. This would assure an interest of five per cent on the capital required to make the alterations as detailed, viz., $220,000,000 in round numbers. It is therefore clearly evident that the time has come when the change from steam to electricity as motive power on a large railway system in a fairly thickly populated European country can be attempted with the assurance that the resultant economies will reimburse the additional capital outlay. The average revenue of German railways is 5.07 per cent, according to comparative data collected in 1902. The revenue of the Prussian railway system, as shown by the data, was 5.04 per cent in 1904.

In view of the degree of confidence awakened by the various exhaustive studies of experts, such as the one summarized above, for the leading railway network in the empire, there is a general opinion that in the early future electricity will displace steam, entirely or in great part, on all the leading German lines.

Signal Devices on the Battleship Fleet.

The cruise of the battleship fleet afforded an extended opportunity for trying out the several new devices for communication at sea between ships. The methods include the semaphore, the submarine signal bell, the wireless telegraph, and the radio-telephone. Each of these has proved successful from various viewpoints.

The wireless telegraph has proved its value many times where great distances have been covered, but the latest marvel, the radio-wireless telephone, is reported to have more than filled the expectations of the officers of the fleet. Its low power was often drowned out by the more dominant telegraph, but properly attuned speech is a factor that seems destined to fill a still more important part in communication at sea.

THE ELECTRIC DISCHARGE AND THE PRODUCTION OF NITRIC ACID.[1]—III.

BY WILLIAM CRAMP AND BERTRAM HOYLE.

Having shown upon what conditions each form of discharge depends, we may proceed to examine the chemical results obtained with the discharge between conductors, as shown in Fig. 7. We have then the following variables to consider:

1. The effects of the use of nozzles of different diameter.
2. Effect of change of current.
3. Effect of change of air velocity.
4. Effect of alteration of spark-gap length.
5. Effect of change of capacity of the circuit.

The comparison of these variables was carried out as follows:

One variable having been decided upon, everything else in the circuit was kept constant. The air which passed through the discharge had a free exit, and a known portion of it was drawn off at a known rate by means of an aspirator through a flask containing a weak solution of caustic soda of a known strength.

This solution contained a little phenolthalene as a color indicator. As the gas was bubbled slowly through the flask the absorption of the oxides of nitrogen caused the indicator to lose its color. The time taken for the color to disappear completely was taken as a measure of the amount of acid produced in that time. As the bubbling was slow, and as, moreover, ozone did not effect the color, the results obtained are fairly reliable relative figures. Each point on a curve is the average of a number of readings, and the consistency of the curves testifies to the efficiency of the method. For this means of detecting and measuring the acid we are entirely indebted to Mr. S. J. Peachey of the School of Technology.

Attention should here be redirected to the complex nature of this discharge. It has been pointed out that, besides the nitrogen arc thread flames, there is always a blue oscillatory discharge present, and the rough distinction in the yield of these two types has been noted. We shall first direct attention to the general conditions governing the yield of peroxide from the flame (A), and afterward examine the probable effect of the presence of the oscillatory discharge (B).

The ordinates used in the curves given are relative figures only, and may need a little explanation.

"Relative amount of acid (N_2O_4) produced per minute" is a convenient figure from which the true acid output may be obtained.

"Relative acid strength" is another convenient figure, which represents the concentration of the gas (N_2O_4) given off. From this figure the true acid concentration may be obtained in grammes of N_2O_4 per cubic centimetre, by simply multiplying by a suitable constant.

Having calibrated a nozzle for cubic feet per minute due to a given pressure in pounds per square inch, and having taken the time (t) in seconds for the indicator to turn colorless, it is possible to calculate the strength of acid produced and its amount in grammes of N_2O_4 per cubic centimetre and grammes of N_2O_4 produced per minute, respectively.

Let A = cubic feet per minute (total amount of air passing through the nozzle).

t = time in seconds for the indicator to turn colorless.

In our experiment twenty-five cubic centimetres of the test solution were used, and this quantity was found to be neutralized by 0.001164 gramme of N_2O_4.

Knowing the time (t) for this operation, and the volume of gas sampled in that time, it is possible to calculate approximately the grammes of N_2O_4 per centimetre of the resulting gas, that is, the "true acid strength."

Then, knowing the cubic feet of air supplied per minute to the nozzle, we can get the grammes of N_2O_4 evolved per minute, or the "true amount of acid produced per minute."

Figures for relative values are:

$\frac{100\ A}{t}$ for relative amount of acid produced per minute, and $\frac{100}{t}$ for relative acid strength.

Example.—Grammes of N_2O_4 per minute, coming through the test bottle,

$$= \frac{0.001164 \times 60}{t}.$$

Since the gas was always taken over at a measured rate of 19.5 cubic centimetres per second, the grammes of N_2O_4 per cubic centimetre in the gas will be:

$\frac{0.001164}{t \times 19.5}$; this is true acid strength.

Therefore grammes of N_2O_4 produced per minute

$$= \frac{0.001164 \times (\text{total c.c. of air supplied to nozzle per minute})}{t \times 19.5}$$

Our curves are based on ordinates "relative acid strength" and "relative amounts of acid produced per minute" for convenience of plotting.

The true values may be obtained by multiplying the respective ordinates by the constants about to be determined.

True Acid Strength.—The ordinate of the relative acid strength curves is $\frac{100}{t}$.

$$\text{Constant} = K = \frac{t \times 0.001164}{100 \times t \times 19.5} = 5.97 \times 10^{-7}.$$

Thus any ordinate representing relative acid strength will give true acid strength in grammes of N_2O_4 per cubic centimetre when multiplied by K.

True Acid Output.—Similarly the ordinates of the relative acid output curves may be multiplied by another constant, K′, so as to give true acid output in grammes of N_2O_4 produced per minute.

Relative amount of acid produced per minute is taken as $\frac{100\ A}{t}$.

True acid output in grammes of N_2O_4 produced per minute $= \frac{0.001164}{t \times 19.5}$ (total cubic centimetre of air supplied to the nozzle per minute).

$$K' \text{ then} = \frac{0.001164}{t \times 19.5} \times (\text{cubic centimetres per minute}) \times \frac{100\ A}{t}$$

$= 0.01685$ approximately.

Thus when an ordinate marked "relative amount of acid produced per minute" is multiplied by this K′, the result is "true acid output of N_2O_4 in grammes per minute."

For example, take the largest acid output recorded in the experiments, where the ordinate "relative amount of acid produced per minute" is 10.1.

The true acid output is—

$10.1 \times 0.01685 = 0.170$ gramme per minute.

The power used is 1.25 kilowatts in this particular example, the primary current being thirty amperes.

Grammes per kilowatt-hour—

$$= 0.17 \times 60 \times \frac{1.25}{1}.$$

Kilogrammes per kilowatt-year

$$= \frac{0.17 \times 60 \times 24 \times 365}{1.25 \times 1{,}000},$$

$= 71.5$ approximately.

1. Abstract of a paper presented before the Manchester (England) Local Section, Institution of Electrical Engineers, November 3, 1908.

Taking the equation for the production of nitric acid from N_2O_4 as being—

$$N_2O_4 + H_2O = HNO_2 + HNO_3,$$

we get that ninety-two grammes of N_2O_4 combine with eighteen grammes of H_2O and give 110 grammes of commercial nitric acid.

Therefore kilogrammes of $HNO_2 + HNO_3$, or commercial nitric acid, per kilowatt-year

$$= 71.5 \times \frac{110}{92} = 85.5,$$

which, for a plant of such small capacity, is a large yield.

In the example given the time taken for the indicator to turn colorless was thirty-six seconds, so that the relative acid-strength ordinate would be $\frac{100}{36}$.

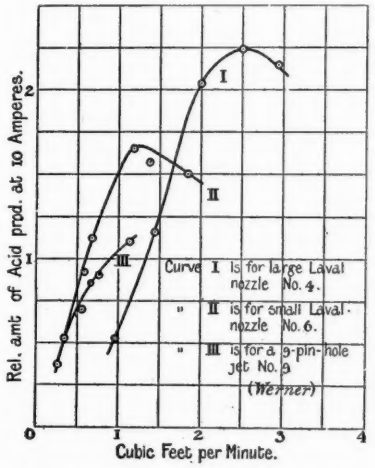

Rel. amt of Acid prod. at 10 Amperes.
Cubic Feet per Minute.
Curve I is for large Laval nozzle No. 4.
" II is for small Laval nozzle No. 6.
" III is for 9-pin-hole jet No. 9 (Werner)

FIG. 11.—RELATION OF ACID PRODUCTION TO VOLUME OF AIR FROM DIFFERENT NOZZLES.

True acid strength is therefore

$$\frac{100}{36} \times 5.97 \times 10^{-7},$$

$= 1.65 \times 10^{-6}$ grammes of N_2O_4 per c.c.

In connection with the above statements we again wish to call attention to the fact that we do not lay stress on the absolute values obtained in this work, but that chief importance is to be attached to the relative figures and to the direction in which they tend when considering the possibility of obtaining a maximum yield for a given apparatus.

A. YIELD OF PEROXIDE.

I. *Effect of Change of Nozzle.*—To begin with, nine nozzles (numbered consecutively) were tried; of these numbers 1 to 8 were of the "Laval" type. No. 9 was the Werner nine-hole jet. For all of these, curves were taken connecting volume of air passed per minute and air pressure on the jet in pounds per square inch. From these curves three nozzles—Nos. 4, 6 and 9 (No. 9 being the Werner jet)—were selected, and preliminary tests were taken connecting relative acid output with cubic feet per minute at a

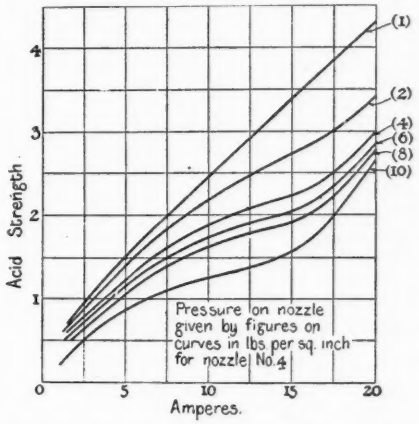


FIG. 12.—ACID PRODUCTION AND POWER FOR VARIOUS NOZZLE PRESSURES.

constant current of ten amperes. The results are shown in Fig. 11.

The practical deductions apparent from these curves are as follows:

1. The greater the amount of air passed by the jet for a given pressure, the greater is the maximum acid output.

2. The greater the amount of air passed by any given jet, the less is the maximum acid concentration.

From these two it follows that with increased quantity of air the amount of acid produced increases faster than the

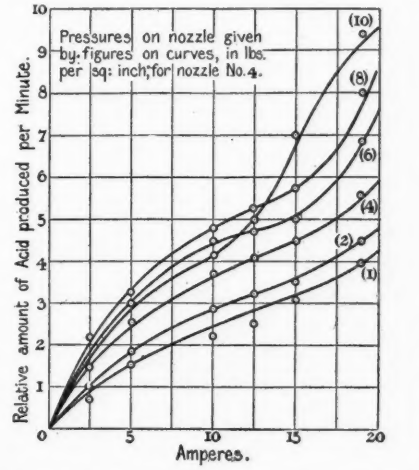


FIG. 13.—ACID STRENGTH FOR VARIOUS CURRENT STRENGTHS AND NOZZLE PRESSURES.

concentration diminishes, and therefore for a large yield per kilowatt-year with such an apparatus, a nozzle giving low concentration will probably be necessary.

The shape of the curves is probably due to the fact that up to a certain maximum the increased temperature gradient increases both output and concentration, after which the decreased mean temperature reduces the maximum acid ever formed. The falling away of the curve with large quantities of air tends to show that a point may be reached when, for a given current, no N_2O_4 is produced. This is borne out by later experiments.

From these curves and the pressure-volume curve for the nozzles, No. 4 was selected for further work, so that in all future curves the nozzle is one of the constants.

II. *Constant Nozzle, Constant Air-gap* (= 0.5 centimetre)—(*a*) Varying current. (*b*) Varying pressure.

Figs. 12 and 13 show a series of curves each for one nozzle pressure. The curves connect amount of acid with current, and concentration with current, respectively.

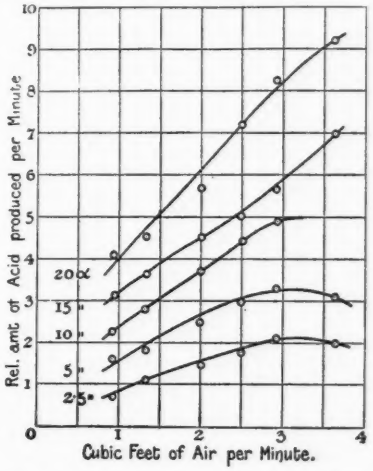


FIG. 14.—RELATION OF ACID PRODUCTION TO AIR VOLUME.

The practical deduction evident from these is that for this gap-length increase of current is invariably accompanied by an increased yield until a limit is reached.

Figs. 14 and 15 are deduced from 12 and 13, respectively. They emphasize the deductions made from curve 11 in that the concentration falls off rapidly with increased quantity of air, but the amount of acid produced increases rapidly up to a certain limit with the same conditions.

Special interest attaches to the case of the curve in Fig. 12 for ten pounds pressure. It is the only case in which any crossing or overlapping occurs, and was consequently carefully checked. The explanation is to be found under the heading of "Effect of Frequency."

III. *Effect of Change of Air-gap Length.*—In this case the first variable is current for each size of air-gap and for each pressure. The different curves are

marked with figures indicating the pressure in pounds and the air-gap to which they refer. The results obtained are specially interesting, and may be followed in Fig. 16. It is seen that when the gap is small there is clearly a current at which the yield is a maximum. This is quite in accordance with what might be expected, in view of the fact that a large current passing through a short gap would of necessity raise the mean temperature; so that soon a limit is reached at which

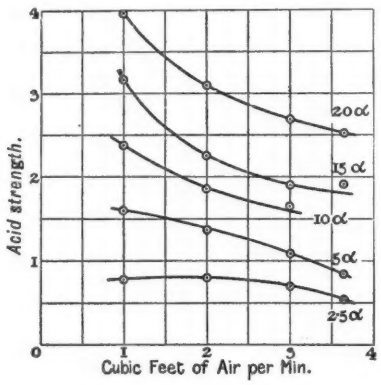


FIG. 15.—RELATION OF ACID STRENGTH TO AIR VOLUME.

the increase of peroxide due to current is counteracted by increase of mean temperature and consequent dissociation.

The deductions from the curves may be summarized as follows:

1. Increase of current gives an increased yield up to a certain maximum for each length of gap.

2. The greater the quantity of air passed through the gap, the higher is this maximum for each gap.

In Fig. 17 curves are shown connecting the gap length with amount of air and concentration for various constant currents. The curves are in duplicate. In the case of the upper curves an electrostatic voltmeter was connected across the gap for measuring the pressure, and for the lower curves the voltmeter was taken off. This effect of the presence of the voltmeter was very marked, and is referred to under the heading of frequency. These curves have been plotted specially to bring out a point already more than once referred to, namely, that there is a maximum yield for each current corresponding to a given gap length, and though this maximum for each gap length is higher the greater the current, yet to obtain the best results the gap length must be accommodated to the current to be used.

IV. *Effect of Change of Frequency.*—It has already been pointed out that the presence of the high-tension voltmeter altered the acid output. That this was due to high-frequency discharge is supported by the fact that the insertion of a hot-wire ammeter in the voltmeter circuit showed a very considerable resonance current to be flowing therein. Such a resonance current would be proportional to the frequency of the oscillation. Knowing the capacity and current in the surging circuit and the voltage acting, the frequency of the oscillations can be calculated. The actual frequencies across the gap at any instant may be different from those given, for the following reasons:

1. Voltmeter capacity varying with deflection.

2. Even if the capacity in circuit remained constant the current taken for a given voltage is not necessarily proportional to the frequency, since it also depends on the wave-form. The wave-form is very likely altered with a change of current in the primary affecting the regulation of the machine.

3. No allowance has been made for the capacity currents due to the leads out of the transformer.

From a series of curves connecting the capacity current with the main current it is apparent:

1. That the higher the blast pressure

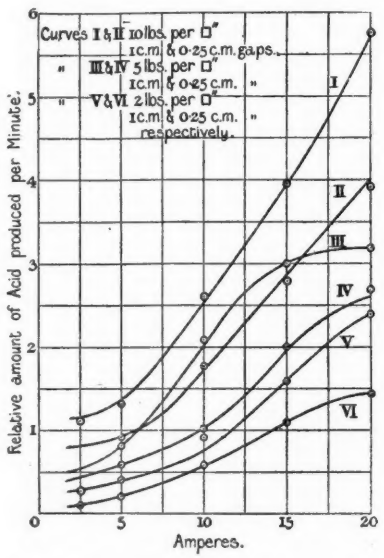


FIG. 16.—CURVES SHOWING EFFECT OF CHANGE OF AIR-GAP LENGTH.

the more pronounced is resonance at certain currents.

2. That the higher the blast pressure the higher is the value of the current at which oscillations are set up, and the more prominent they are.

Attention has already been called to the fact that the ten-pound curve is very irregular. Closer examination shows that the ten-pound curve is that which shows the greatest resonance effect, and further, that the irregularity of the output corresponds with the changes of frequency. Thus between two and fifteen amperes in Fig. 12 the output is most irregular, and

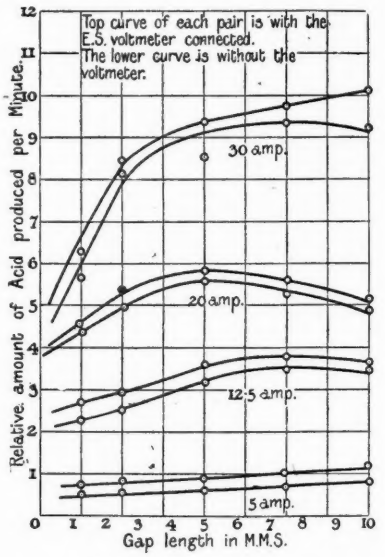

Top curve of each pair is with the E.S. voltmeter connected.
The lower curve is without the voltmeter.
Relative amount of Acid produced per Minute.
Gap length in M.M.S.
30 amp.
20 amp.
12·5 amp.
5 amp.

FIG. 17.—EFFECT OF CHANGE IN AIR-GAP LENGTH ON CONSTANT-CURRENT ACID PRODUCTION.

it is just here in Fig. 17 that the oscillation effects are most pronounced.

We have endeavored to find out whether a very high frequency in the discharge always corresponds to high acid yield, but in vain; for the subject is much complicated by the presence of more than one frequency, and by the fact that such changes in frequency alter not only the pressure, but also the current flowing as well as the amount of ozone produced. We think, then, that while it must be conceded that the question of the effect of frequency is undetermined, if not altogether indeterminate, it must also be allowed that the presence of a high frequency, in so far as it admits of large capacity currents across the arc and probable production of ozone, is to be considered on the whole as likely to increase the yield of peroxide, which fact we consider is clearly proved by the curves in Fig. 17.

The yield of ozone by the oscillatory discharge has been shown (by Prépogno) to increase with the frequency used, and as we consider that the presence of ozone has no small effect in the formation of peroxide of nitrogen from the flame, we think that from this cause alone the effect of high frequency would be sufficient to increase the yield as shown in Fig. 17.

[To be concluded.]

PRIME MOVERS.—II.[1]

BY CHARLES P. STEINMETZ.

III.

The suitability of the different types of prime movers for the various economic and other requirements of electric service, as discussed before, are best seen by considering their characteristic features.

The available types of prime movers are:

The hydraulic turbine—the impulse type, the reaction type, and their various combinations.

The steam engine—condensing and non-condensing, with and without superheat.

The steam turbine—condensing and non-condensing, with and without superheat.

The gas engine—using the available fuel directly, as natural gas, blast-furnace gas or liquid fuel.

The gas engine—with producer plant converting solid fuel into gas.

The gas turbine does not yet exist, but as it undoubtedly will arrive some time, some consideration is given to it in the following

HYDRAULIC PRIME MOVER.

The most prominent characteristic of hydraulic power is its dependence on meteorological conditions, dry seasons, freshets, ice in the water supply; and mechanical and electrical interference with the transmission lines connecting the power with its market. As a result the reliability of hydraulic power is inherently far below that of steam power. To give the same class of electric service, therefore, the reliability charge, in the form of duplication of plant, of steam reserve, etc., is far higher than with a steam plant close to its market. In this respect climatic conditions naturally exert a great effect.

The fixed cost is usually very high, due to the expensive hydraulic development required. It is especially high if water storage has to be provided; but this also depends largely on the local conditions of the water power.

The proportionate cost is, however, very low, due to the absence of cost of fuel. This is the redeeming feature of the hydraulic plant, which gives it an advantage over steam power. Nevertheless, even with an extremely low proportionate cost, the high fixed cost and the high cost of reliability insurance greatly reduce the difference in the cost of steam power and of water power of the same quality. Under very unfavorable conditions it may even make the water power more expensive than the steam power.

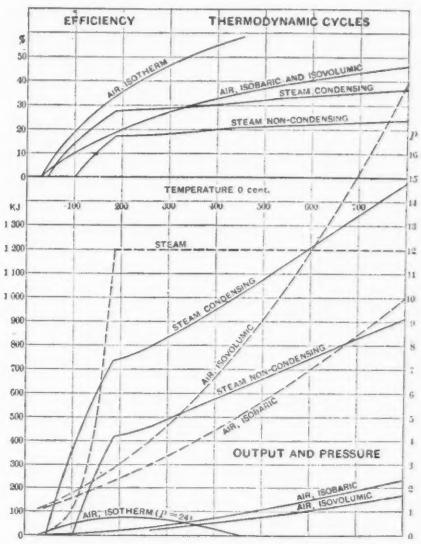


FIG. 1.—SPECIFIC ENERGY OF VARIOUS WORKING MEDIUMS.

Owing to the high fixed cost and low proportionate cost, water power depends on a good load-factor still more than does steam power, to such an extent that it may occasionally be economical to oversell the water power, thereby keep constant load on it, and take care of peak loads, etc., by auxiliary steam plant.

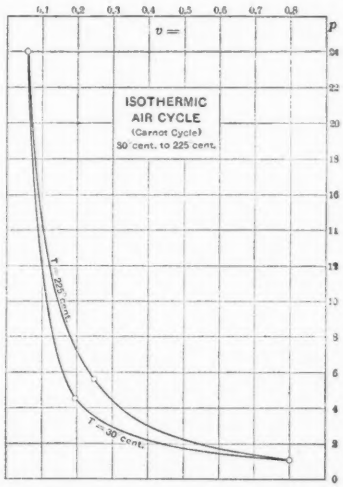


FIG. 2.—THE CARNOT OR ISOTHERMIC AIR CYCLE.

THERMODYNAMIC PRIME MOVERS.

The thermodynamic efficiency is essentially a function of the temperature difference on which the engine operates. The mechanical efficiency, maintenance cost and reliability depend largely on the mechanical and temperature stresses in the prime movers, the available energy per unit weight and unit volume of the working fluid—steam or air—and on the speed of the engine.

To compare the different types of prime movers in this respect to determine how far certain features, as high mechanical stresses, low space economy, high thermodynamic efficiency, etc., are inherent in the type of prime mover requires a study of their thermodynamic cycles.

In Fig. 1 is plotted, with the temperature in degrees centigrade as abscissas, the available energy in kilojoules per kilogramme of the working medium—steam or air—for the three typical air cycles, and for steam used non-condensing and condensing, in the latter case with a condenser pressure $p = 0.1$ kilogramme per square centimetre, or about twenty-seven inches vacuum; that is, about the average between that of the steam turbine and that of the reciprocating engine. The corresponding pressures are shown in dotted lines, and the thermodynamic efficiencies in the upper part of Fig. 1. Figs. 2 to 6 give some typical cycles and Tables I and II the constants of these cycles.

A pressure limit of $p = 12$ kilogrammes per square centimetre (about 170 pounds per square inch) is assumed for steam, while for the air cycles a maximum of twice this pressure has been allowed.

As will be seen in Fig. 1, the isothermic or Carnot cycle, that is, constant temperature admission, adiabatic expansion, constant temperature exhaustion and adiabatic compression, does not give any appreciable output, nor can it use considerable temperature differences without going to impracticable pressures. Thus its existence is limited to the text books of thermodynamics. With a maximum pressure $p = 24$, the maximum energy available for the Carnot cycle is 78 kilojoules per kilogramme of air, or about one-tenth of the available energy of saturated steam at half this pressure, and occurs at the relatively low upper temperature of 225 degrees centigrade. This cycle is shown in Fig. 2, and is the "fattest" Carnot cycle which can exist within the pressure limit of twenty-four kilogrammes per square centimetre. At higher temperatures the efficiency of the Carnot cycle increases, but the output decreases; the output vanishes, by the cycle collapsing into a line, at about 455

1. A paper (slightly condensed) presented at the meeting of the American Institute of Electrical Engineers, in New York, February 19, 1909.

degrees centigrade, or at a temperature far below that permissible in gas engines.

The curve for the isovolumic air cycle, that is, constant volume admission (constant volume combustion) and constant volume exhaust is the cycle of the theoretical or ideal gas engine. The curve for the isobaric cycle, that is, constant pressure admission and constant pressure exhaust would be the cycle of the gas turbine. These curves are calculated for the conditions of maximum available energy between the given temperature limits. Under this condition the thermodynamic efficiency is much lower than the maximum possible thermodynamic efficiency as represented by the Carnot cycle. It is: $\pi = 1 - \sqrt{\frac{T_2}{T_1}}$ for the isovolumic as well as the isobaric cycle of maximum energy, while the efficiency of the isothermic cycle is $\pi = 1 - \frac{T_2}{T_1}$, where T_1 is the maximum, T_2 the minimum absolute temperature reached during the cycle. The thermodynamic efficiency of these cycles can be increased by going to higher pressures, but the output and thus the mechanical efficiency are decreased thereby.

It is interesting to note that the available energy of the air cycle per kilogramme of air is insignificant until higher temperatures are reached; but even at a temperature of 800 degrees centigrade, it is still much lower than that of the non-condensing steam cycle. It must be considered, however, that the volume of steam per unit weight is fifty-eight per cent greater than that of air at the same temperature and pressure. The thermodynamic efficiency of these cycles is less than that of the steam cycle for lower temperature, but rises far above it at higher temperatures.

The relatively low pressure is interesting. This pressure gives the maximum output in an isobaric air cycle and shows that the development of the gas turbine will take place at relatively moderate pressures.

In Figs. 3 and 4 are shown the isovolumic and isobaric cycles for 800 degrees centigrade, maximum temperature and the same conditions of maximum available energy as in Fig. 1. Obviously the high-pressure peak at the beginning of the expansion, in Fig. 3, is cut off by delayed combustion, etc. Even at the highest temperature the maximum output pressure of the isovolumic cycle does not reach that occurring in the Carnot cycle at an insignificant output.

The steam curves in Fig. 1 are interesting by the very rapid rise and very high values of available energy. Thus in the

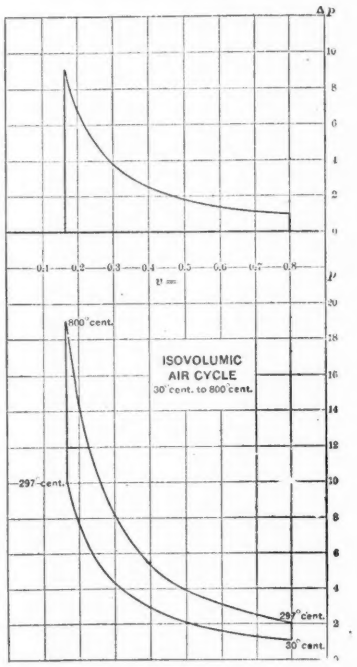


FIG. 3.—ISOVOLUMIC AIR CYCLE.

temperature interval of 141 degrees centigrade, between boiler and condenser temperature, the steam cycle gives per kilogramme more than four times the available energy of the isovolumic air cycle in the temperature interval of nearly 800 degrees centigrade. Obviously, the

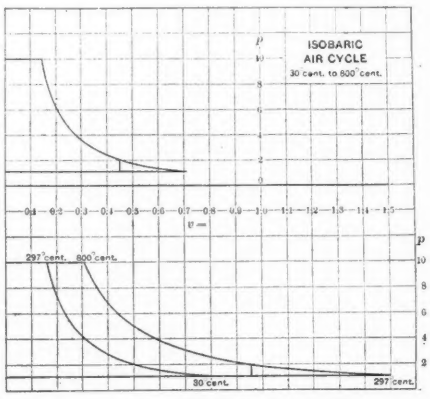


FIG. 4.—ISOBARIC AIR CYCLE.

cause is the partial condensation of the steam, which makes the enormous latent heat of steam available.

The efficiency of the saturated steam cycle is virtually the same as that of the Carnot cycle, that is, the theoretical maximum possible for the utilized temperature interval. However, the pressure rises very rapidly, and the temperature interval which can be used in the saturated steam cycle is limited thereby. Hence from the temperature of 187 degrees centigrade, corresponding to the steam pressure of $p = 12$, the further increase of temperature occurs not at saturation and with rising steam pressure, but at constant steam pressure by superheat.

These curves of superheated steam show the small increase of available energy of superheat, until very high superheats, gas-engine temperatures, are reached. They show especially the very small increase of thermodynamic efficiency resulting from superheat. Thus doubling the temperature range (141 degrees centigrade) of condensing saturated steam, by 141 degrees centigrade superheat, increases the available energy only by 17.5 per cent, and the efficiency by one per cent. Increase of the temperature range of steam by superheat, therefore, does not increase the thermodynamic efficiency of the cycle correspondingly, and the steam cycle, while more efficient than the air cycle at low temperature, drops below it in thermodynamic efficiency at higher temperature. While the efficiency of the temperature range beyond saturation temperature is higher in accordance with the thermodynamic laws, the amount of work done in this range is such a small part of the total work that it does not appreciably increase the total efficiency.

The increase of efficiency of the steam cycle by superheat is not due to an increase of thermodynamic efficiency of the cycle, but is due to the decrease of losses, mainly those resulting from the condensation of moisture; that is, it is essentially an increase of what has previously been considered as mechanical efficiency.

The available energy of superheat becomes considerable only at very high temperatures, and the thermodynamic efficiency, therefore, increases. However, for the total range from boiler temperature of 187 degrees centigrade to gas-engine temperature of 800 degrees centigrade, the additional available energy of superheat about equals that of the steam in the 141 degrees range below saturation, and the thermodynamic efficiency rises by only nine per cent, thus drops far below gas-engine values. This is important as indicating the losses of thermodynamic efficiency, resulting by limiting the temperature of combustion in gas cycles by injecting water.

Beyond the point marked by a circle

on the steam curves, the steam remains superheated even at exhaust pressures; that is, the cycle occurs entirely within the gas range. Obviously, this point is shifted to lower temperatures in the turbine engine by the re-evaporation of moisture by mechanical losses.

It is interesting to note the large amount of available energy of steam below atmospheric pressure, 350 kilo-joules

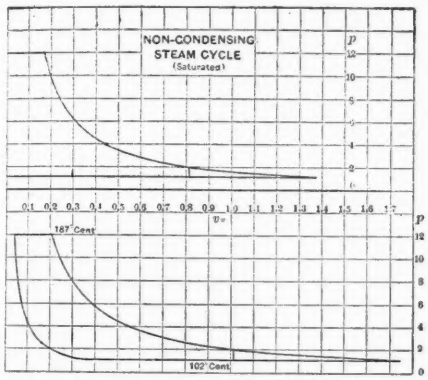


FIG. 5.—CYCLE OF NON-CONDENSING SATURATED STEAM.

per kilogramme of steam, which is used in the low-pressure steam turbine.

Fig. 5 gives the cycle of non-condensing saturated steam, and Fig. 6 the turbine cycle of condensing saturated steam.

Comparing Figs. 4 and 5 illustrates the greater width of the area of the steam cycle. In Figs. 3, 4, and 5 the cycle is shown in the upper part of the diagram, modified by substracting the compression curve from the expansion curve, as this gives the area and thereby the available energy in a form more convenient for comparison.

Characteristic of all thermodynamic cycles, Figs. 4, 5, 6, is the very large volume at the end of the expansion; that is, the area runs out in a long and low triangular shape. To carry the adiabatic expansion down to exhaust pressure, therefore, would require abnormally large cylinder volumes in a reciprocating engine, and correspondingly larger mechanical losses; therefore the expansion has to be broken off long before exhaust pressure is reached, about as indicated in the curves, or even at still higher pressures. As a result the reciprocating engine cannot get the full benefit of very low condenser pressures, while the turbine engine is not limited in this respect. For instance, between $p = 0.07$, or 28 inches vacuum, and $p = 0.2$ as the pressure at the end of the expansion of a reciprocating engine, the available energy per kilogramme of steam is 153 kilojoules, or about thirty-seven per cent of the total energy of the non-condensing steam cycle. Of this only 100 kilojoules, or about two-thirds, is used in the steam engine, while the total is used in the turbine. Hence the steam turbine gains far more by high condenser vacuum than the reciprocating engine. With a steam turbine of condenser pressure $p = 0.07$ (twenty-eight-inch vacuum) the available energy of the steam would be higher by forty-two kilojoules than the steam curve in Fig. 1.

To show the relative magnitude of the quantities, the results of six typical cycles are calculated in Tables I and II.

As seen from Table II, the available energy E per kilogramme of working medium is highest for steam with condensation, lowest for the Carnot cycle of air. The weight w of steam or air, required per 1,000 kilojoules of available energy, is given in column 6, and varies between 0.68 kilogramme for steam superheated to 800 degrees centigrade, and 12.8 kilogrammes for the Carnot cycle. Column 7 shows the maximum volume v_0, per 1,000 kilojoules, assumed by the working medium at the end of the expansion. Here 2^a, 3^a, and 4 are such as to show the impracticability of these cycles for an engine in which the maximum volume is of importance; that is, a cylinder engine. Cycles 2^a and 3^a thus are turbine cycles.

At the same piston speed, that is, the same number of revolutions and same

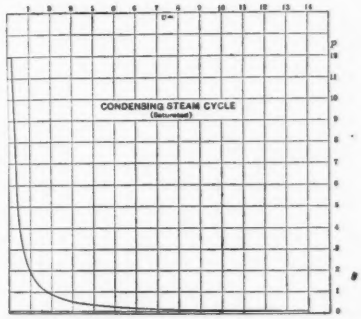


FIG. 6.—TURBINE CYCLE OF CONDENSING SATURATED STEAM.

piston stroke, the product of maximum pressure (column 4) and maximum volume (column 7) is proportional to the piston pressure, and these relative piston pressures: $P = pv_0$, are given in column 8. This column is an indication of the mechanical strains which have to be taken care of in the engine design.

Column 8 shows the impracticability of utilizing the full pressure range of a condensing steam engine in a single cylinder, even if it were otherwise permissible—due to the excessive piston pressure resulting in this case; it also shows the enormous reduction of piston pressure by subdivision of the expansion—from 24.6 to 11.6 in the compound, non-condensing engine, and from 104 to 7.0 in the triple-expansion, non-condensing engine with saturated steam. Very striking, however, are the much higher piston pressures of the air cycle; that is, the gas engine: 84 in the isobaric and 62.5 in the isovolumic cycles, compared with seven in the condensing triple-expansion steam engine. While by different assumptions, regarding pressure, temperature, etc., the numerical values may be considerably varied, the differences between the two types of engines are of such magnitude as to exhibit a characteristic or inherent feature of the cycles.

In the last four columns are given, for 1,000 kilowatt output, the values of cylinder volume, in cubic metres and cubic feet of a kilogramme of steam or air con-

TABLE I.—DATA COMPUTED FOR SIX TYPICAL CYCLES.

1. *Saturated steam, non-condensing.* Fig. 5.
   - *a.* Expanding from: $p_1 = 12$; $v_1 = 0.166$; $T_1 = 187°$ cent.
     to: $p_2 = 1.1$; $v_2 = 1.38$; $T_2 = 102°$ cent.
   - *b.* Expansion terminated at: $p_1' = 2$; $v_2' = 0.81$.
   - *c.* Compound engine, low-pressure cylinder: $p_1' = 3.5$; $p_2 = 1.1$.
2. *Saturated steam, condensing.* Fig. 6.
   - *a.* Expanding from $p_1 = 12$; $v_1 = 0.166$; $T_1 = 187°$ cent.
     to: $p_2 = 0.1$; $v_2 = 11.5$; $T_2 = 46°$ cent.
   - *b.* Expansion terminated at $p_2' = 0.2$; $v_2' = 6.2$.
   - *c.* Triple-expansion engine. Expansion terminated at: $p_2' = 0.2$; $v_2' = 6.2$. Low-pressure cylinder: $p_1' = 0.8$.
3. *Superheated steam of Gas-engine temperature,* 800° cent.
   - *a.* Expanding from: $p_1 = 12$; $v_1 = 0.38$; $T_1 = 800°$ cent.
     to: $p_2 = .1$; $v_2 = 17.5$; $T_2 = 98°$ cent.
   - *b.* Expansion terminated at $p_2' = 0.2$; $v_2' = 9.4$.
   - *c.* Triple-expansion engine. Expansion terminated at: $p_2' = 0.2$; $v_2' = 9.4$. Low-pressure cylinder; $p_1' = 0.8$.
4. *Air, isothermic (Carnot), cycle.* Fig. 2.
   Expanding from: $p_1 = 24$; $v_1 = 0.06$; $T_1 = 225°$ cent.
   to: $p_2 = 1.1$; $v_2 = 0.8$; $T_2 = 30°$ cent.
5. *Air, isobaric cycle.* Fig. 4.
   Expanding from: $p_1 = 10$; $v_1' = 0.31$; $T_1 = 800°$ cent.
   to: $p_2 = 1.1$; $v_2 = 1.5$; $T_2' = 297°$ cent.
   Compressing from: $p_2 = 1.1$; $v_2' = 0.8$; $T_2 = 30°$ cent.
   to: $p_1 = 10$; $v_1 = .166$; $T_1' = 297°$ cent.
6. *Air, isovolumic cycle.* Fig. 3.
   Expanding from: $p_1 = 19$; $v_1 = 0.166$; $T_1 = 800°$ cent.
   to: $p_2' = 2.1$; $v_2 = 0.8$; $T_2' = 297°$ cent.
   Compressing from: $p_2 = 1.1$; $v_2 = 0.8$; $T_2 = 30°$ cent.
   to: $p_1' = 10$; $v_1 = 0.166$; $T_1' = 297°$ cent.

sumed per kilowatt-hour, and the total efficiency, under the assumption of sixty per cent mechanical efficiency of the steam cycle and fifty per cent mechanical efficiency of the air cycle*, for a double-acting engine of seventy-five revolutions per minute, under the assumption of sixty per cent boiler and furnace efficiency, that is, ratio of heat units supplied to the engine to heat units representing the chemical energy of the fuel. The efficiences of the air cycles are given for 100 per cent producer efficiency, that is, the case of gaseous or liquid fuel. In brackets are added the efficiencies for a plant making its gas from coal, assuming seventy-five per cent producer efficiency.

Table II shows the characteristic and inherent differences between the steam engine, steam turbine and gas engine. The steam turbine can utilize the expansion as far down in pressure as condenser design permits, and is of smaller size than the steam engine, due to the higher velocities permissible by the rotary motion.

Characteristic of the gas engine, compared with the steam engine, are higher piston pressures, thus heavier reciprocating masses, and thereby heavier construction, larger sizes, and greater mechanical losses, and lower space economy, especially when compared with the steam turbine. From the higher mechanical stresses inherent to the gas engine must be expected a lower reliability of service, or a higher class of the required attendance, or a more difficult and expensive engine design. Also characteristic of the gas-engine cycle is a very much higher thermodynamic efficiency which, even when allowing for the lower mechanical efficiency resulting from the higher mechanical stresses, is still very far above that of the steam engine, especially when gaseous fuel is directly available, and no producer plant is required.

In general, however, in discussing gas engines, the two distinctly different cases must be separated:

a. Where gaseous or liquid fuel is available, as in the blast furnace gas, natural gas, the automobile engine.

b. Where gaseous fuel has to be produced from coal by a separate plant.

When balancing the advantages of higher efficiency against the disadvantages resulting from the higher mechanical stresses, the difference between the two cases may often be the determining feature in the choice of the prime mover for maximum total economy.

TABLE II.—DATA SHOWING THE CHARACTERISTIC AND INHERENT DIFFERENCES BETWEEN STEAM ENGINE, STEAM TURBINE AND GAS ENGINE.

			Thermodynamic Cycles.								
1	2	3	4	5	6	7	8	9	10	11	12
Available Energy per Kg.	Thermodynamic Efficiency.	Maximum.			Per 1,000 *K.-J.* Available Energy.		Relative Piston Pressure, $P = p\,v_0$	Per 1,000 Kw. Output, at 60% Resp., 50% Mechanical Efficiency, 60% Boiler and Furnace Efficiency, Double-acting Engine, 75 Rev. per Min.			
								Cylinder Volume.		Kg. per Kw.-Hour, Steam or Air.	Total Efficiency.
K.-J.	%	Temperature, ° Cent.	Pressure, Kg. per Cm².	Volume m³ per Kg.	Weight, Kg.	Max. Volume, m³		m³	*c b* ft.		
$^*E$	η	T	p	V	w	v_0		V		W	
		1. Non-condensing. Saturated Steam. *a.* Turbine Cycle.									
416	17.4	187	12	1.38	2.40	3.32	39.8	2.21	78	14.4	6.3
		b. Engine Cycle.									
395		187	12	.81	2.53	2.05	24.6	1.37	48	15.2	6.1
		c. Low-pressure Cylinder of Compound Engine.									
416		138	3.5	1.38	2.40	3.32	11.6	2.21	78	14.4	6.3
		2. Condensing. Saturated Steam. *a.* Turbine Cycle									
734	27.8	187	12	11.5	1.34	15.7	188	10.5	370	8.0	10.0
		b. Engine Cycle.									
715		187	12	6.2	1.40	8.7	104	5.8	205	8.4	9.8
		c. Low-pressure Cylinder of Triple-expansion Engine.									
715		93	0.8	6.2	1.40	8.7	7.0	5.8	205	8.4	9.8
		3. Condensing. Steam Superheated to Gas Engine Temperature (800° C.). *a.* Turbine Cycle.									
1,480	37.0	800	12	17.5	0.68	11.8	142	7.9	280	4.1	13.3
		b. Engine Cycle.									
1,460		800	12	9.4	0.69	6.4	77	4.3	152	4.2	13.1
		c. Low-pressure Cylinder of Triple-expansion Engine.									
1,460		300	0.8	9.4	0.69	6.4	5.1	4.3	152	4.2	13.1
		4. Isothermic Air Cycle. (Carnot Cycle.)									
78	37	225	24	0.8	12.8	10.3	247	8.2	290	92	18.5 (14)
		5. Isobaric Air Cycle. (Turbine Cycle.)									
240	47	800	10	1.5	4.17	6.25	62.5	5.0	176	30	23.5 (17.6)
		6. Isovolumic Air Cycle. (Engine Cycle.)									
172	47	800	19	0.8	5.83	4.65	84	3.7	130	42	23.5 (17.6)

In a turbine engine, at 135 m. sec. wheel-speed, the maximum section of the steam passages (at the exit side of the last low-pressure wheel) would in 2*a*, the condensing steam turbine of exhaust pressure $p=0.1$, be only 1,490 cm², or 1.5 sq. ft., against 370 resp. 205 cu. ft. cylinder volume per 1,000 kw. output.

In a gas turbine, 5, the maximum outflow section under the same conditions would be only 660 cm², or less than 0.75 sq. ft., compared with 130 cu. ft. cylinder volume in 6, per 1,000 kw. output.

*By mechanical efficiency is understood the ratio of mechanical output to the available energy of the cycle. The mechanical efficiency thus includes all of the losses between the available energy and the indicated engine output, as condensation, radiation, delayed combustion, throttling, steam friction, etc., which are not included in the ratio of brake horsepower to indicated horsepower.

Wisconsin Engineers Form State Society.

The organization of the Engineering Society of Wisconsin was completed at the first meeting, held at the University of Wisconsin, February 24 to 26, at which 150 city engineers, general managers of power and traction companies, contracting engineers, superintendents of water and light plants, mechanical and civil engineers, and superintendents of highway construction were present and became charter members.

The officers elected were: President, Dean F. E. Turneaure, University of Wisconsin College of Engineering; vice-president, McClelland Dodge, city engineer of Appleton; trustees for two years, B. F. Lyons, assistant general manager Beloit Gas and Electric Company, and E. P. Worden, mechanical engineer, Prescott Steam Pump Company, Milwaukee; and trustees for one year, E. Gonzenbach, Sheboygan Light, Power and Railway Company, and E. R. Banks, city engineer of Superior. These, as the executive board, will elect the secretary later.

The new organization will hold annual meetings for the purpose of bringing together the engineers from all parts of the state interested in the solution of such problems as arise in connection with municipal plants, large construction work, bridge, forest and waterpower questions and light and power production. A wide range of subjects was included in the programme for the initial meeting of the society.

At the opening session, February 24, following the address of welcome by President Charles R. Van Hise, was a presentation of the scope of the highway work of the State Geological Survey, by W. O. Hotchkiss, highway engineer for the Survey. A. R. Hirst, also of the State Highway Department, spoke on the use of tar, oils and emulsions on macadam and earth roads. The discussion on pavements was led by McClelland Dodge, city engineer of Appleton.

Prof. W. D. Pence, who is engineer for the Wisconsin Railroad Commission, opened the second day's programme with a description of the organization of the commission's engineering staff. The new problem of standards of gas and electric service was discussed by Prof. C. F. Burgess of the department of applied electrochemistry at the university, who has done important work in enabling the State Railroad Commission to prescribe a standard for fuel and illuminating gas.

The electric interurban roads of Wisconsin were made the subject of an address by F. G. Simmons, superintendent of construction and maintenance of way for the Milwaukee Electric Railway and Light Company. The day circuit for small towns was discussed by Prof. J. W. Shuster, and new forms of arc lamps, by W. E. Wickenden, also of the electrical engineering department of the university.

The second night was given to a discussion of waterpowers, W. G. Kirchoffer describing the water supply of the city of Marshfield, and Prof. D. W. Mead the subject of hydraulic and hydroelectric power development. Papers on the waterproofing of concrete, by F. M. McCullogh, city engineer of Stoughton; municipal engineering in the Orient and in Porto Rico, by J. T. Hurd and Edwin Wray; gas producers and small power stations, by V. E. McMullen, Beloit, and C. T. Atkinson; and Madison's concrete storm sewer system, by City Engineer John F. Icke, concluded the convention programme.

The Institute Dinner.

Everything points to a very successful anniversary dinner of the American Institute of Electrical Engineers at the Hotel Astor, New York city, on March 11. All the preparations have now been carefully made, and the number of applications for seats is very large. The dinner will be conducted by President Ferguson, who will act as toastmaster. Prof. Elihu Thomson will speak for the charter members; Frank J. Sprague for the past-presidents; Dr. A. C. Humphreys, president of Stevens Institute of Technology, will speak on electrical engineering and education, and John Bogart, formerly state engineer, and secretary in 1884 of the American Society of Civil Engineers, will bring the greetings and congratulations of sister societies, several of which will be represented by their officials. An interesting feature of the dinner will be the participation also of a number of branches and sections. The dinner committee makes an earnest request that the applications for tickets and seating be filed at once, so that attention can be given to this important matter well in advance of the affair. The cost of the dinner is only $5, including one wine and cigars and cigarettes, music, etc. The dinner will be given in the large ballroom, using the small ballroom adjoining as an annex if necessary.

British Illuminating Engineering Society.

At an informal dinner, held in London, February 9, the formation of an Illuminating Engineering Society in England was the subject of discussion. Leon Gaster presided over this gathering, at which representatives of the engineering, architectural, medical and other interested professions were present.

At the conclusion of the dinner Mr. Gaster briefly described the development and progress of the illuminating-engineering movement in England, and explained the objects of the proposed society, namely, to provide a free and impartial platform for the discussion of questions connected with illumination. He emphasized especially the fact that what he proposed was an "Illuminating Engineering Society" and not a Society of "Illuminating Engineers."

An animated discussion followed, in which all who spoke expressed their warm approval of the suggested scheme, and their conviction that the time was ripe for starting such a society. It was proposed and carried unanimously that *The Illuminating Engineer,* published in London, be appointed the official organ of the society.

For further particulars regarding this society, application should be made to Leon Gaster, 32 Victoria Street, London, S. W.

A New Radio-Active Substance?

A substance which was described as like radium but less harmful and expensive and called radio-thor or tho-rad-x was exploited by Dr. E. Stillman Bailey of the Hahnemann Medical College of Chicago before the Southern Homeopathic Medical Association at its convention at New Orleans.

Dr. Bailey recently made an analysis of a pitchblende obtained in Colorado, and asserted that he had obtained the substance he exhibited in the course of his investigations.

He declares that it has all the properties of radium, and with it he can photograph objects through six inches of wood.

"One of our most curious experiments with the new substance," said Dr. Blackmar, "was the taking of a photograph through a stove lid on which some radiothor had been spread. The powerful rays of this material passed through the iron plate, thus permitting a photograph of a number of pennies and other articles on the opposite side."

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

ROCHESTER RAILWAY COMPANY.

The report of the Rochester Railway Company for the quarter ended September 30, 1908, compares as follows:

	1908.	1907.
Total railway oper. revenues	$732,512	$740,770
Total railway oper. expenses	462,767	464,546
Net railway oper. revenues	$269,745	$276,224
Net revenue from outside oper.	1,101	693
Total net revenues from oper.	$270,846	$276,917
Taxes accrued	46,891	34,353
Operating income	$223,955	$242,564
Total deductions from gross	78,456	73,038
Net corporate income	$145,498	$169,526

BIRMINGHAM RAILWAY, LIGHT AND POWER.

The Birmingham Railway, Light and Power Company reports earnings for January, 1909, compared as follows:

	1909.	1908.
January gross	$192,343	$177,745
Expenses and taxes	119,635	125,802
January net	$ 72,707	$ 51,942
Interest, charges and sk. fund.	44,783	43,780
January surplus	$ 27,924	$ 8,162

PACIFIC TELEPHONE AND TELEGRAPH.

The Pacific Telephone and Telegraph's report for the year ended December 31, 1908, compares as follows:

	1908.	1907.
Gross	$10,699,650	$9,223,564
Expenses, taxes, int., etc.	8,924,179	7,828,416
Net	$ 1,775,471	$1,395,148
Dividends	1,080,000	1,080,040
Surplus	*$ 695,471	$ 315,108

*Balance for common dividends after payment of 6 per cent on the preferred stock is equal to 3.8 per cent earned on the $18,000,000 common stock.

The total expended during the year on plant and real estate was $2,473,179.

KINGS COUNTY ELECTRIC LIGHT AND POWER COMPANY.

The Kings County Electric Light and Power Company has issued its report for 1908, which shows as follows:

		1908.	1907.
Gross earnings		$3,613,470.37	$3,471,740.43
Operating expenses, including general, technical, production and distribution expenses		1,747,757.48	1,786,395.25
Net over operating		$1,865,712.89	$1,685,345.18
Bond discount written off	$ 16,935.60		
Miscellaneous charges canceled	7,846.97	24,782.57	50,000.00
		$1,840,930.32	$1,635,345.18
Depreciation charges		404,857.06	242,931.77
		$1,436,073.26	$1,392,413.41
Fixed charges for bond interest		606,560.00	606,560.00
		$ 829,513.26	$ 785,853.41
Dividends paid		800,000.00	764,000.00
Profit and loss surplus		$ 29,513.26	$ 21,853.41
Previous profit and loss balance	$1,181,213.05		
Less adjustment of accounts previous year	3,151.99	1,178,061.06	1,159,359.64
Total profit and loss balance		$1,207,574.32	$1,181,213.05

President A. N. Brady states in part:

"During the year the company has cooperated cordially with the Public Service Commission, and all of its business methods and policies have been under thorough investigation. All inquiries have been promptly and fully answered, and the officers believe that the company has the general good will of its customers and the public.

"While the commercial depression during the past year has been felt by the company in a reduction of its usual rate of growth, it has, notwithstanding that fact, been able to so regulate its expenses as to show a net gain.

"An increased demand for the company's service has been manifested, especially during the last quarter of the year, and the officers believe that the year 1909 will be a successful one."

MACKAY COMPANIES.

The Mackay Companies has issued its annual report for the year ended January 31, 1909. The income account compares as follows:

February 1 to January 31, receipts:	1909.	1908.
Income from investments	$3,685,761	$3,830,390
Disbursements:		
Dividends paid to stockholders of Mackay Companies.	3,655,216	3,655,216
Operating expenses, etc.	25,027	22,251
Balance carried forward	$ 5,518	$ 152,923

The report states that the Mackay Companies still owns the whole or part of the capital stock of 102 prosperous cable, telegraph and telephone companies in the United States, Canada and Europe, including the entire capital stock of the Commercial Cable Company and the various companies constituting the land line system known as the Postal Telegraph.

Notwithstanding this decrease in the gross receipts and net profits of the Commercial Cable Company, and notwithstanding the depression of business which prevailed throughout the United States during the past year, the profits, which the Mackay Companies might draw from the companies which it controls, have increased. Economies, which have been rendered possible without impairing the service, have more than offset the decrease in gross receipts. The service now rendered by the telegraph and cable systems controlled by the Mackay Companies is faster and more efficient than ever before.

During the past year additional wires have been strung on one of the transcontinental land lines, and the service of the Postal Telegraph Companies has been extended to Tonopah and the mining regions of that district in the western part of the United States. An additional transcontinental route will be put into operation in 1909 by building from Salt Lake City, Utah, to Sacramento, Cal.

At the annual meeting of the Mackay Companies the directors were re-elected, the total number of votes cast being 567,000.

CHICAGO TELEPHONE COMPANY.

Gross earnings of the Chicago Telephone Company in 1898, as reported at the annual meeting of stockholders, were only slightly in excess of those in the preceding year. Expenses were cut, however, and the amount available for dividends was larger by about $330,000. The dividend requirements in the past year were $2,012,790, as compared with $1,472,713 in 1907, owing to the heavy increase in the capital stock.

Following is the company's financial statement for 1908 and a comparison:

	1908.	1907.
Gross revenue	$8,741,517	$8,718,951
General and operating exp.	4,064,940	6,976,868
Repairs and maintenance	2,603,235	.....
Net earnings	$2,073,341	$1,742,083
Dividends	2,012,790	1,472,713
Surplus	$ 60,551	$ 269,370

The balance sheet as of December 31 compares as follows:

RESOURCES.

	1908.	1907.
Plant	$26,115,867	$24,324,112
Real estate and buildings.	2,551,488	2,320,035
Other investments	82,933	92,820
Bills and accounts receivable	613,475	751,836
Material on hand	424,813	397,738
Furniture and fixtures, etc.	436,860	369,059
Cash	455,364	157,837
Total	$30,680,801	$28,413,437

LIABILITIES.

Capital stock	$27,000,000	$17,564,124
Reserve for deferred maintenance	1,838,840	1,831,714
Miscellaneous reserve	780,037	571,414
Bills and accounts payable	377,246	3,331,242
Surplus	$30,680,801	$28,413,437

The stockholders re-elected the old directors as follows: Arthur D. Wheeler, John M. Clark, D. M. Cummings, J. Russell Jones, Chauncey Keep, Robert T. Lincoln, T. W. Robinson, B. L. Smith, A. A. Sprague, B. E. Sunny and T. N. Vail. The directors then re-elected the retiring officers. In his report to the stockholders the president said:

"The net increase in the number of telephone stations for the year was 29,537 and the total number of stations connected at the close of the year was 231,-

180. Because of the general business depression the volume of traffic to the end of October was no greater than for 1907, notwithstanding the increased number of telephones, but since that time there has been a satisfactory increase. We have now 8,119 employes, as compared with 7,681 a year ago. There was expended on the operating department during the year $103,000 more than during the previous year. The property has been carefully maintained at an expenditure of $2,600,000, or thirty per cent of the gross receipts, and is in good condition throughout.

"The increase in the number of telephones has for some time averaged 30,000 per annum. For the current year we have planned for an increase of 40,000 telephones. This will call for the purchase of real estate, the erection of buildings, the necessary addition of conduits, cables, poles, wires, switchboards, etc. In order to secure the funds necessary for the purpose at the lowest rate of interest the board of directors recommended to the stockholders that a first mortgage be placed upon the property of the company to secure an issue of five per cent bonds. This recommendation was concurred in, and the $5,000,000 of bonds were sold at a price slightly under par. The proceeds, which were received after December 31, 1908, and do not appear on this trial balance, are now on deposit to our credit."

METROPOLITAN DISTRICT RAILWAY, LONDON.

The report of the directors of the Metropolitan District Railway Company of London for the half year ended December 31, 1908, compares with the corresponding six months of 1907 as follows:

Six months ended December 31:	1908.	1907.
Receipts	£261,874	£224,463
Expenditures	153,868	156,069
Net revenue	£108,006	£ 68,394
Other income	31,631	28,488
Total income	£139,637	£ 96,882
Interest, rents, etc.	128,024	131,273
Available for dividends	£ 11,613	*£ 34,391
Four per cent on guar. stock	10,937	10,937
Carried forward	£676	*£ 45,328

*Deficit.

NATIONAL CARBON COMPANY.

Net earnings of the National Carbon Company in the fiscal year ended January 31, as reported at the annual meeting of stockholders, were $980,000. This compares with $924,000 in the preceding fiscal period. The amount applicable to dividends on the common stock was $258,000, or about 4.7 per cent on the $5,500,000 of common outstanding.

The company's earnings and expenses for the year ended January 31 compare as follows:

	1909.	1908.
Net income after adjustment of inventory	$980,283	$924,801
Dividends on preferred stock	315,000	315,000
Dividends on common stock	220,000	220,000
Charges to depreciation	400,000	350,000
Accounts written off	7,019	5,050
Balance to profit and loss account	38,264	34,751

The stockholders re-elected the retiring directors. The board at a meeting in New York re-elected the old officers without change.

WEST PENN RAILWAYS.

The West Penn Railways Company has issued a statement of operations, covering the calendar year 1908. The report compares with 1907 as follows:

	1908.	1907.
Gross	$1,551,138	$1,603,100
Expenses	859,264	841,767
Net	$ 691,874	$ 761,333
Charges	446,306	416,734
Surplus	$ 245,568	$ 344,599
Preferred dividend	137,500	137,500
Surplus	$ 108,068	$ 207,099

UNITED RAILWAYS OF ST. LOUIS.

The report of the United Railways Company of St. Louis for the year ended December 31, 1908, compares as follows:

	1908.	1907.
Gross	$10,593,166	$10,828,737
Expenses and taxes	*6,737,460	7,043,882
Net	$ 3,855,706	$ 3,784,855
Other income	.....	.....
Total income	$ 3,855,706	$ 3,784,855
Deductions—		
Interest on bonds, etc.	1,852,310	1,864,310
Int. on St. L. Tr. fd. debt.	500,000	500,000
St. L. & Sub. R. R. bonds.	391,000	391,000
Miscellaneous interests	55,428	22,713
Preferred dividends	849,160	649,160
Total deductions	$ 3,647,898	$ 3,427,183
Surplus	207,808	357,672

*Includes depreciation, $527,856 in 1908, $540,182 in 1907, $455,681 in 1906 and $421,752 in 1905; none charged in former years; also taxes, which in 1908 aggregated $632,193 and in 1907 $617,547.

The report of the United Railways of St. Louis for the month of January, 1909, compares as follows:

	1909.	1908.
January gross	$829,036	$827,398
Expenses	544,752	554,359
January net	$284,284	$273,039
Charges	235,568	233,454
January surplus	$ 48,716	$ 39,585

NORTH AMERICAN COMPANY.

The North American Company has issued its annual report for the year ended December 31, 1908. The income account compares as follows:

	1908.	1907.
Total receipts	$1,723,186	$1,610,965
Rent, taxes, etc.	274,024	206,322
Undivided profit	*$1,449,162	$1,404,643
Dividends	.....	1,117,211
Balance	$1,449,162	$ 287,432
Commissions paid	.....	.....
Surplus for year	$1,449,162	$ 287,432

*Equal to 4.86 per cent on the $29,793,300 capital stock.

LONDON UNDERGROUND.

The Underground Electric Railways of London reports gross earnings for the week ended February 6 and for five weeks ended February 6 compared as follows:

	1909.	1908.
Bakerloo	£ 3,355	£ 3,035
Piccadily	5,820	5,390
Hampstead	3,730	3,145
District	9,748	9,036
Tramways	4,922	5,239
Total	£ 27,625	£ 25,845
Total to date, five weeks	140,027	128,807

KNOXVILLE RAILWAY AND LIGHT.

The Knoxville Railway and Light Company reports earnings for January, 1909, compared as follows:

	1909.	1908.
January gross	$48,217	*$38,505
Expenses and taxes	24,668	26,785
January net	$23,549	$11,720
Interest charges	11,483	11,447
January surplus	$12,065	$ 272
Reserve and emergency fund	.....	.....
January balance	$12,065	$ 272

*The lighting earnings in January 1908, were reduced about $6,000 by a change to the continuous system of meter reading. This explains $6,000 of the apparent increase over last year. The remaining $3,700 represents an actual increase in both railway and electric departments of about 10 per cent.

MONTREAL STREET RAILWAY.

The report of the Montreal Street Railway Company for the month of January and four months ended January 31 compares as follows:

	1908.	1907.
January gross	$ 295,453	$ 285,515
Expenses	202,344	202,504
January net	$ 93,109	$ 83,011
Charges, etc.	30,836	31,933
January surplus	$ 62,273	$ 51,078
Four months, gross	1,230,524	1,188,238
Expenses	759,639	742,027
Four months, net	$ 470,885	$ 446,211
Charges, etc.	113,305	115,187
Four months, surplus	$ 357,580	$ 331,024

AMERICAN TELEPHONE.

The American Telephone and Telegraph Company reports for January, 1909, compared as follows:

	1909.	1908.
Dividends	$2,681,300	$2,467,152
Interest and other revenue	893,730	837,268
Telephone traffic (net)	392,500	383,500
Real estate	8,062	16,007
Other sources	126,313	81,571
Total	$4,101,906	$3,790,498
Expenses	180,674	160,282
Net	$3,921,232	$3,630,216
Interest, etc.	774,010	633,394
Surplus	$3,147,222	$2,996,822

LITTLE ROCK RAILWAY AND ELECTRIC.

The Little Rock Railway and Electric Company reports earnings for the year ended December 31, 1908, compared as follows:

	1908.	1907.
Twelve months, gross	$670,897	$642,010
Operating expenses and taxes	339,234	330,169
Twelve months, net	$331,663	$311,841
Interest charges	111,677	101,367
Sinking fund	10,000	.....
Total int. and sinking fund	$121,677	$101,367
Surplus	209,986	210,474
Reserve funds	36,000	100,000
Balance	$173,986	$110,474

Telephones in the United States.

The Department of Commerce and Labor, Bureau of the Census, has compiled a preliminary report on the number of telephones in the United States on December 31, 1907. These figures are given in the accompanying table.

United States	Total. 6,118,578	Independent (Non-Bell). 2,986,515	Bell (American T. & T. Co.) 3,132,063	Independent Stations Connected with Bell System. *835,880
Alabama	40,481	14,985	25,496	3,944
Arizona	6,203	3,148	3,055	.....
Arkansas	49,576	32,150	17,426	10,265
California	237,672	65,977	171,695	9,607
Colorado	65,908	4,473	61,435	1,620
Connecticut	63,898	1,815	62,083	352
Florida	17,522	11,160	6,362	3,691
Georgia	62,260	26,204	36,056	9,072
Idaho	16,394	5,754	10,640	1,288
Illinois	558,585	285,322	273,263	109,101
Indiana	289,452	216,990	72,462	50,065
Iowa	332,545	279,773	52,772	74,806
Kansas	200,233	161,913	38,320	66,880
Kentucky	93,996	51,796	42,200	9,038
Louisiana	35,692	6,184	29,508	4,351
Maine	53,134	16,024	37,110	7,830
Maryland, District of Columbia and Delaware.	110,282	19,896	90,386	217
Massachusetts	209,383	5,324	204,059	650
Michigan	209,842	106,049	103,793	30,933
Minnesota	171,479	114,618	56,861	46,547
Mississippi	37,627	13,567	24,060	5,235
Missouri	312,527	220,823	91,704	82,393
Montana	17,168	8,118	9,050	846
Nebraska	153,279	105,610	47,669	45,252
Nevada	4,601	2,081	2,520	734
New Hampshire	28,920	6,488	22,432	2,482
New Jersey	116,988	19,134	97,854	831
New Mexico	6,653	3,476	3,177	759
New York	685,512	180,759	504,753	23,992
North Carolina	37,104	20,597	16,507	4,714
North Dakota	34,087	26,635	7,452	10,542
Ohio	495,636	312,278	183,358	29,284
Oklahoma	68,125	38,009	30,116	36,570
Oregon	49,629	16,223	33,406	10,675
Pennsylvania	450,403	174,582	275,821	11,976
South Carolina	20,911	7,872	13,039	1,867
South Dakota	48,405	44,751	3,654	25,939
Tennessee	71,130	25,758	45,372	9,241
Texas	187,862	108,832	79,030	30,334
Utah	30,630	10,528	20,102	451
Vermont	30,833	13,917	16,916	7,020
Virginia	55,541	24,118	31,423	4,447
Washington	98,846	35,652	63,194	9,168
West Virginia	62,144	46,609	15,535	3,238
Wisconsin	158,875	89,005	69,870	36,366
Wyoming and Rhode Island	30,605	1,538	29,067	1,267

*Figures furnished by American Telephone and Telegraph Company included in total for Independent.

A Five-Watt, Four-Candlepower Sign Lamp.

Following the Wednesday noon luncheon in the grill room of the Chicago Automombile Club the talk before the Electric Club of Chicago, February 24, was given by J. R. Cravath on the subject of "Illuminating Engineering." The speaker's remarks were confined to the general aspects of the new science of illumination, calling attention to the great advances made in comparatively recent years in placing new and more efficient illuminants, reflectors, systems and, above all, exact data in the hands of the illuminating engineer. With Homer E. Niesz presiding, discussion of the subject was taken up by G. H. Jones, W. H. Bonham, Albert Scheible and E. H. Haughton.

Mr. Haughton told the club of a new sign lamp, of which the first commercial order is now being manufactured, using the tungsten filament. These lamps require only five watts each and give four candlepower, although, on account of their very high specific brilliancy, a group or bank of these small units viewed from a distance gives the impression of containing very much larger lamps. The tungsten sign lamps are supplied with current at nine to eleven volts. In the case of very large signs the ten-to-one step-down transformers are made to be mounted directly on the sign itself in order to avoid the use of a large amount of copper in the low-pressure leads. The low voltage of these sign lamps is made necessary by the present impossibility of constructing a sturdy tungsten filament so fine as to take only energy for its low candlepower when connected across the usual commercial-voltage mains.

Relation of Load Factor to Power Costs.

A joint meeting of the Chicago Section of the American Institute of Electrical Engineers and the Electrical Section of the Western Society of Engineers was held in the rooms of the latter on the evening of March 2. W. L. Abbott presided over the meeting, which was exceptionally well attended, the assembly hall being completely filled. The subject for discussion was "The Relation of Load Factor to Power Costs." Papers on the subject were presented by E. W. Lloyd, of the Commonwealth Edison Company, C. A. S. Howlett, of the Western Electric Company, and J. M. S. Waring, of the Chicago office of the Electric Storage Battery Company.

Mr. Lloyd in his paper showed that consideration of the load factor was a logical basis in fixing power costs. Almost invariably the true maximum load of any consumer is much less than his connected load. The average load factors of a large number of classes of service in Chicago were given and the method of rating them described. A plea was made for joint action toward a more specific definition of load factor than is given in the A. I. E. E. standardization rules.

In the absence of Mr. Howlett, on account of illness, his paper was read by H. L. Grant of the Western Electric Company. The motor manufacturer's point of view was taken by the author, who stated that in electrically equipping factory plants there has been a tendency to put in motors that were too large. This has resulted in giving the installation a low load factor and in making a dissatisfied customer for both the central station and the motor manufacturer. To overcome this, co-operation between the central-station solicitor, the consumer and the motor manufacturer was needed.

Mr. Waring's paper opened with a general discussion of the question of power rates. It was shown that the ideal to be striven for was an equitable prorating of all the costs connected with the production of electric power among all the consumers of that power. To attain this the fixed charges of the power company should be met by a primary charge upon the consumers proportional to their maximum demands. The operating expenses should be met by a secondary charge proportional to the actual energy consumption. The author then analyzed a large number of typical power rates of both steam and waterpower plants. He concluded his paper with a statement of the advantages of the installation of a storage battery by the consumer to reduce his maximum peak and therefore his primary charges.

A general discussion of the subject was then taken up by W. L. Abbott, J. F. Gilchrist, H. R. King, W. B. Jackson, P. Junkersfeld, G. H. Atkin, A. H. Babcock, F. J. Postel, James Lyman, W. B. Storey, Jr., J. L. Hecht, S. M. Bushnell and Mr. Lloyd.

QUESTIONS AND ANSWERS.

MEMBERSHIP IN THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—I am thinking of joining the American Institute of Electrical Engineers, Los Angeles Section, and would like to know what are the qualifications for membership. Is an examination required? What are the initiation fees and dues?—C. O. S., Los Angeles, Cal.

Membership in the American Institute of Electrical Engineers consists, according to its constitution, of associates, members and honorary members. The qualifications for members are very high. An applicant must first be elected as an associate and then, if eligible, he may make application for transfer to full membership. Election as an associate is not so difficult, for any person not less than twenty-one years of age who is interested in or connected with the study or application of electricity may apply for admission to the Institute as an associate. All applications must be made out on blanks that may be obtained from the secretary, Ralph W. Pope, 33 West Thirty-ninth Street, New York city, or from the various local secretaries. In this application there should be given the names of three members or associates of the Institute who are personally acquainted with the applicant and will vouch for his professional and moral standing in the community. The applicant also gives a brief record of his professional or commercial experience. No examination is required. The initiation fee is $5 and the annual dues are $10 for associates.

"MOTORING" OF COMPOUND GENERATORS.—If there are two compound, direct-current generators running in multiple and one of them becomes "motored," how can it be detected and what is the best method to reverse the polarity of the "motored" machine? On a direct-current multiple line, will a ground on one side of the line affect the generators, and if so, to what extent?—M. A. L., Peoria, Ill.

The "motoring" of a generator running in parallel with one or more generators is readily detected in a number of ways. The surest indication is that the needle of the ammeter of the "motored" machine will read back of zero, showing that the armature current has reversed; this, however, depends on the use of an ammeter having a permanent magnet, as nearly all good direct-current ammeters do; if the ammeter is one of the "soft-iron" type, its needle will gradually read less and less as the machine is losing its share of the generator load till at the moment it changes to a motor it will read zero, and from this point on it will begin to read forward again, even though the current is reversed. If the generator is belted to its prime mover a marked changing over of the tight and loose sides of the belt takes place at the moment the generator becomes a motor. Even if the generator is direct-connected, a noticeable change in the customary sound produced by the set is readily detected by an observant attendant. This is due to the fact that the change from generator to motor is generally not perfectly smooth but rather of a pulsating character, which causes heavy and sudden changes of load of the engine or other prime mover.

To bring the "motored" machine back to normal condition as a generator, reversal of its polarity is not necessary, but merely a strengthening of its field excitation by readjusting the shunt-field rheostat till the voltage of the machine is equal to that of the bus-bars. If the machine became "motored," due to a decrease in speed caused by increased belt slippage, deficient steam pressure, or other trouble, this should be corrected in preference to strengthening of the field or the field readjusted again after it is corrected.

A ground on one side of a multiple line will not affect the generators as long as the insulation of the other side remains perfect throughout. However, to guard against possible trouble from a simultaneous ground on the other side, any ground ought to be cleared up as quickly as possible.

WATTS AND CANDLEPOWER AND THEIR RELATED PROBLEMS.—What is a watt and a kilowatt? What connections have amperes and volts with watts? If a consumer burns ten sixteen-candlepower, 110-volt, 3.5-watt lamps 100 hours each, what should be his bill at the rate of ten cents a kilowatt? How many candlepower does a 100-watt, 110-volt lamp produce? How are these problems figured out?—W. W., St. Louis, Mo.

A watt is the unit of electric power and represents a certain rate of expenditure of electrical energy; it is equal to the power of a circuit carrying a current of one ampere at a difference of potential of one volt; therefore to find the watts expended in any circuit or device, multiply the number of amperes by the number of volts. To find the volts if the watts and amperes are given, divide the watts by the amperes; to find the amperes if the watts and volts are given, divide the watts by the volts. These relations hold true strictly for direct currents only; for alternating currents the power-factor is an essential factor with the volts and amperes in finding the product, true watts. A kilowatt is equal to 1,000 watts; in commercial work it is more generally used on account of its convenient size.

In figuring out the problem given it should be borne in mind that electrical energy is usually sold by the kilowatt-hour and that a rate commonly stated to be ten cents a kilowatt is really ten cents a kilowatt-hour; in other words, the product of the power in watts and the time it is used in hours gives the energy used in kilowatt-hours. In the problem the lamps have an efficiency of 3.5 watts per candlepower and consume, therefore, $16 \times 3.5 = 56$ watts each. Ten of the lamps burning for 100 hours consume $56 \times 10 \times 100 = 56{,}000$ watt-hours, or 56 kilowatt-hours. Hence, the cost should be 56×10 cents $= \$5.60$.

As the efficiency of the different classes of incandescent lamps is not the same, the number of candlepower produced by a 100-watt lamp depends on the type of lamp referred to. The efficiency is usually expressed in watts consumed per candlepower. In the following table these facts are given for the modern 100-watt lamps:

Type of Lamp.	Total Watts.	Watts per Candlepower.	Rated Candlepower.
Carbon	100	3.1	32
Gem	100	2.5	40
Tantalum	100	2.0	50
Tungsten	100	1.25	80

Navy Department Supplies.

The Bureau of Supplies and Accounts will open bids at Washington, D. C., for the following electrical material on March 16: Twenty-three magnetic sets, 10,000 feet lampcord, 3,000 porcelain receptacles, miscellaneous magnet wire, for delivery at Brooklyn, N. Y.; 2,200 feet of conduit, miscellaneous supplies, 10,000 feet of lamp wire, miscellaneous rubber-covered wire, for delivery at Norfolk, Va.; one controller, two portable testing sets, for delivery at Annapolis, Md.

Balloon to Have Wireless Receiving Station.

A new venture in aeronautics and wireless telegraphy is to be attempted by members of the Aero Club of New England in the fitting out of the new balloon Massachusetts, and the new dirigible of the Boston and New York Air Line with wireless apparatus at Hotel Somerset in Boston by Charles J. Glidden.

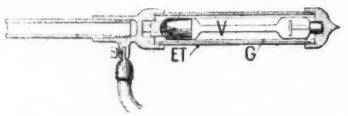
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

HEYLAND-KORDA ROTARY CONVERTER.

In many industrial establishments it is necessary to employ direct current at low voltage, while they receive from the generating station high-tension alternating current. For the purpose of transforming this current, Messrs. Heyland and Korda have invented a new rotary converter, consisting of a combination of unipolar machine and a synchronous motor or homopolar motor with rotating armature, which they described in a paper before the International Congress of Electricity in Marseilles. The machine is based on the following principle: The tension produced in each conductor of the alternating-current winding is not primarily alternating, but pulsating and of constant direction. It only becomes alternating by the connections which join the conductors in series among themselves. However, the same conductors may be connected in such a way, that the pulsations are always added to each other in the same direction. A pulsating direct current will then be obtained, and finally, if the connections are made so that the pulsations are added to each other at a definite phase difference, the result will be a continuous current of constant intensity. A machine on this principle of 150 kilowatts was built last year by the Société Alsacienne de Constructions Mecaniques, of Belfort, and is fully described in the article.—*Translated and abstracted from La Lumiere Electrique (Paris), January 30, 1909.*

A HIGH-TENSION DETECTOR.

This device is intended to indicate if a high-tension current is flowing through a conductor. It consists essentially of an evacuated glass tube with an interior and an exterior electrode. The air has been rarefied to such a degree that the tube lights up brightly at tensions of 1,200 to 20,000 volts. The vacuum tube is enclosed in another glass tube, and the latter again in an ebonite tube with a slot, through which the light may be observed. At one end the tube is covered by a metal cap ending in a point, at the other by a metal socket, to which a long ebonite handle is attached. A flexible conductor is also connected to the socket. In order to determine if a conductor is charged with a high-tension current, the flexible wire is connected to the ground and the pointed cap brought in contract with the



VACUUM-TUBE HIGH-TENSION DETECTOR.

conductor. The device is illustrated in the accompanying figure.—*Translated and abstracted from L'Electricien (Paris), January 30, 1909.*

ARRANGEMENT FOR AUTOMATICALLY CONNECTING ALTERNATING-CURRENT GENERATORS IN PARALLEL.

An apparatus has been designed by Fritz Lux for automatically connecting alternating-current generators in parallel. It also automatically regulates the speed of the machine to be added to the one already running. The construction and operation of the device is the following: A and B in Fig. 1 are two small transformers with three windings each, *a* and *b*, on the one hand, and *c, d, e, f,* on the other hand, being equal. Windings *c, d* and *e, f,* are connected in series, and the

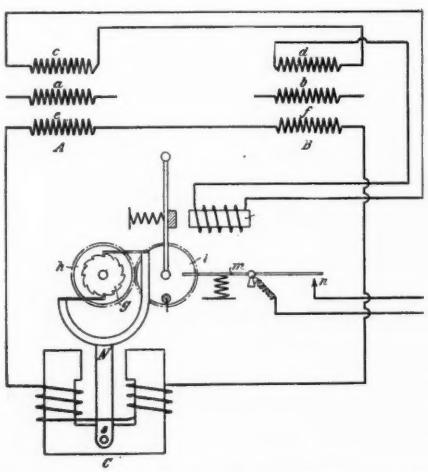


FIG. 1.—APPARATUS FOR AUTOMATICALLY PARALLELING ALTERNATORS.

other two in opposition to each other. C is an alternating-current vibratory motor with two poles and a permanent magnet of small mass between them. Two pawls are attached to this magnet which engage a ratchet wheel. A cog-wheel *h* fastened to the latter engages the teeth of a second cog-wheel *i*, which is suspended like a pendulum and can be disconnected by the influence of the electromagnet *l*, when this is excited. The wheel *i* carries a pin *k*, which by its weight causes the wheel to assume always the same position when it is disconnected from *h*. When the wheel *i* has turned a certain distance, the pin *k* presses against the lever *m* and thereby closes the contact *n*. The process of paralleling is as follows: Assuming the running machine to be connected to the winding *a*, for instance, and the machine to be added to the winding *b*, in case the phases are alike, the tensions of *e* and *f* will be added and the tensions of *c* and *d* will annul each other. In the case of phase difference the opposite happens. Thus, when the phases are alike, the vibrator C will receive current and rotate the ratchet wheel *g*. The electromagnet *l* being without current, the wheel *i* will be turned so long as the phases are equal, the pin *k* will reach the lever *m* and close the contact *n*, whereby the connecting switch is operated. For the purpose of automatically regulating the speed of the machines to be added two vibratory motors are employed, which are made to affect the governor of the engine by means of an electric motor.—*Translated and abstracted from Elektrotechnische Zeitschrift (Berlin), February 11, 1909.*

SPEAKING DYNAMOS AND TRANSFORMERS, A NEW TELEPHONE RECEIVER.

Professor W. Peukert here describes the development of a novel telephone receiver: "I tried," he says, "to magnetize an iron core by an undulatory current such as is produced when a microphone is spoken into. For this purpose a closed ring of soft iron wires was provided with a wire winding and the latter inserted in the circuit of a microphone. When the microphone was spoken into the iron body emitted a low sound; speech was reproduced clearly but faintly. It is known that under certain conditions permanent magnetism may be strongly influenced by weak, variable magnetizing forces. The iron core was therefore simultaneously sub-

jected to a constant magnetizing force by providing it with a second wire winding, through which a direct current was sent. (Fig. 1.) The result was striking, the iron body immediately began to emit a loud sound; with suitable choice of the

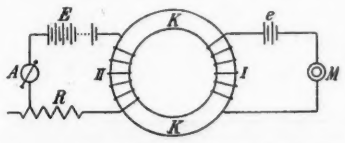


FIG. 1.—SPEAKING TRANSFORMER.

direct-current speech was reproduced so loudly that it could be distinctly heard at a distance of several metres. The experiment was then modified by placing a coil with a soft iron core between the pole-shoes of an electromagnet (Figs. 2 and 3), and with this arrangement also the reproduction of speech was loud and

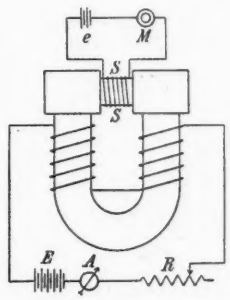


FIG. 2.—SPEAKING ELECTROMAGNET.

distinct. The results had shown that a strong, permanent magnetization of the iron is of importance, and the substitution of the electromagnet by a strong steel magnet readily suggested itself. A horseshoe magnet was combined with an armature provided with a winding and

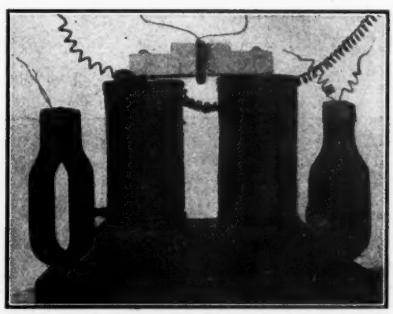


FIG. 3.—SPEAKING MAGNETS.

the experiment repeated. (Figs 3 and 4.) The reproduction of speech was extraordinarily pure and distinct. By giving the proper dimensions and form to the various parts it has been possible to make a new telephone receiver, which distinguishes itself by great simplicity, as it has no vibrating plate or diaphragm. (Fig. 4.) The magnetic circuit of the telephone is closed as perfectly as possible, so that all its particles take part in the vibration. The detrimental overtones of the vibrating diaphragm and troublesome cracking of ordinary telephone receivers are not present. Analogous ex-

FIG. 4.—TELEPHONE WITHOUT DIAPHRAGM.

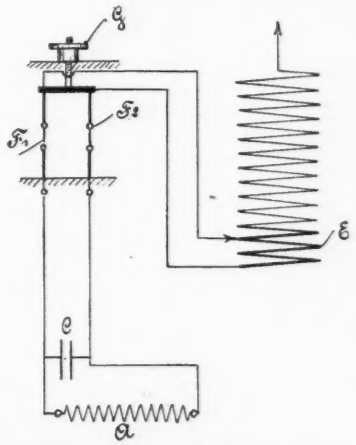
periments were made with dynamos and various alternating-current transformers and the results were equally favorable. The transformers reproduced everything spoken or sung into the microphone with great clearness, so that it could be plainly heard in a large auditorium."—*Abstracted and translated from Elektrotechnische Zeitschrift, Berlin, January 21.*

THE MANUFACTURE OF CARBIDE OF CALCIUM IN JAPAN.

Japan will soon be able to supply all the calcium carbide it requires for its own consumption. The imports of this material into Kobe, for instance, have decreased from 32,442 kilogrammes in 1905 to 360 kilogrammes in 1906. In the beginning of 1906 a Japanese carbide of calcium company was formed with a capital of 1,500,000 francs, which utilizes the Soki waterfalls for generating 10,000 horsepower. This concern is already doing a large business and has bought up three small competing firms. It intends to enlarge its waterpower station at Soki considerably, and even thinks of exporting to Europe. The carbide requirements of Japan are estimated at 90,000 kilogrammes a month, of which 20,000 kilogrammes are consumed in each of the cities of Tokio and Osaka. Two qualities of carbide are sold in Japan, the superior kind costing 40.8 centimes (about 8.1 cents) a kilogramme, and the inferior one 16.6 centimes (about 3.3 cents). The latter cannot be used for lighting.—*Translated and abstracted from L'Electricien (Paris), January 23.*

MODIFIED CONNECTION FOR HIGH-FREQUENCY APPARATUS.

A modified arrangement of a high-frequency circuit is here described by Friedrich Dessauer. Extensive experiments have shown, he says, that in order to make the so-called d'Arsonval apparatus for producing medical high-frequency currents as efficient as possible, it is of advantage to arrange the self-induction between two symmetrical spark-gaps of equal or nearly equal length. The new arrangement is shown diagrammatically in the illustration, in which A is the secondary of an induction coil, or preferably of an alternating-current transformer. C is the capacity, usually a battery of Leyden jars or an oil condenser; E is the self-induction, which consists of a loop between two symmetrically arranged spark-gaps, F_1 and F_2. In the ordinary d'Arsonval apparatus regulation is possible only at the solenoid and the two points of a spark-gap. The construction



EQUI-LENGTH SPARK-GAP HIGH-FREQUENCY APPARATUS.

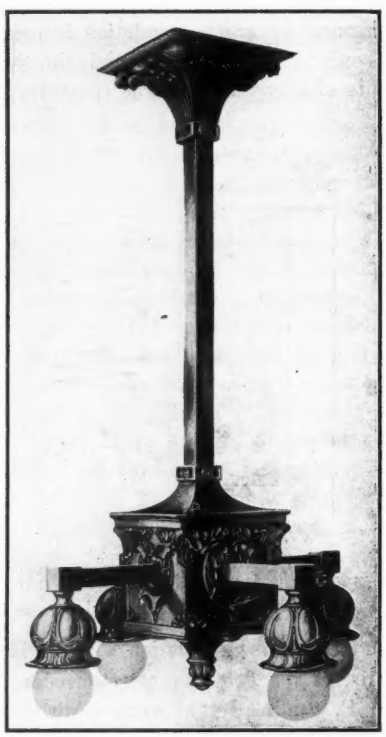
described enables regulation within wider limits, as the two movable electrodes F_1 and F_2 can be set at various distances from the two fixed electrodes by means of the screw, G. The increase in the performance of the secondary resonating coil caused by this arrangement as compared with any of the other known circuit connections with one spark-gap is surprising. The secondary tension and the length of the brush discharge increase about thirty per cent with the same wave-length. The effect takes place only when the high-frequency apparatus is directly fed by alternating current; it is not present when an induction coil and interrupter are used. — *Translated and abstracted from the Physikalische Zeitschrift, Leipsic, January 15, 1909.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

New Designs in Westinghouse-Nernst Chandeliers.

Since the new Westinghouse-Nernst chandeliers were put on the market several attractive variations of the original designs have been added to the list. One of the most pleasing is the square art nouveau cast chandelier shown in the accompanying illustration. It is slightly more massive than the other designs and its ornamental treatment is somewhat more pronounced without, however, sacrificing the simplicity characteristic of all these chandeliers. This design is made with either two or four arms and equipped with 66, 88, 110 or 132-watt lamps, either 110 or 220 volts, as desired. The four-arm 132-watt chandelier has an illuminating value, it is stated, equivalent to twenty-eight sixteen-candlepower carbon-filament lamps.



WESTINGHOUSE-NERNST CHANDELIER.

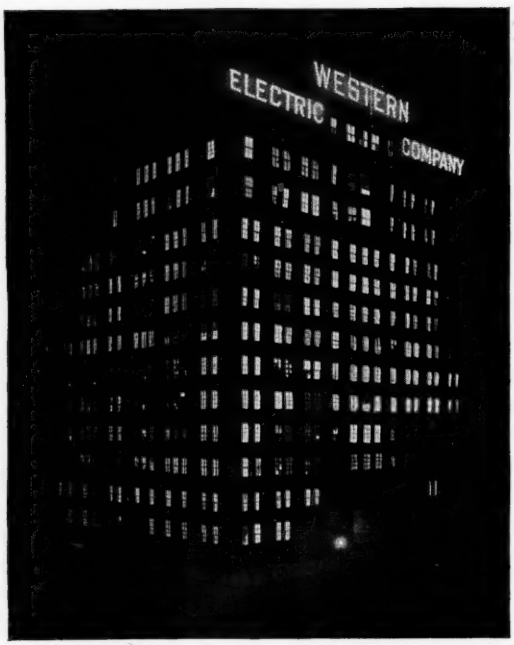
Electric Sign Advertising.

Were it possible for our forebears to witness the revolution that has taken place in our business methods in the last decade, one of the things that would most certainly call forth their astonishment would be the change in the method of advertising. It has passed through many stages, from the lowly, inconsequential place it once occupied in the business world until now it is regarded as the first essential to business success. Ten or fifteen years ago the professional ad-writer was unknown, and billboard advertising was in its infancy. Now we have ingenious press agents and ad-writers commanding enormous salaries. It has become a profession that is attracting some of the most intellectual persons of the country.

The latest, and perhaps the most profitable, method of advertising is by the electric sign. This method has become so popular that it is being adopted the country over in all lines of business.

The value of electric signs for advertising purposes is strikingly demonstrated by the Western Electric Company at both its manufacturing plant at Hawthorne, Ill., and at its building in New York city. In the latter case the company has placed on the top of its thirteen-story structure, which faces on the North River, an electric sign over 200 feet long, with letters nine feet high, made up of 1,000 two-candlepower lights. This sign is conspicuous even from the New Jersey shore. It is viewed by thousands of persons daily, Jersey commuters, passengers on Atlantic liners, coastwise steamers and others.

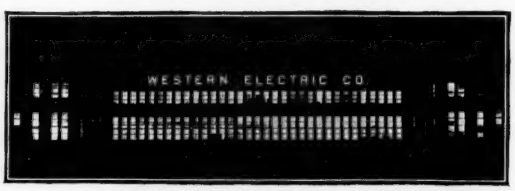
At Hawthorne the company's electric sign faces the main line of the Chicago, Burlington & Quincy Railroad out of Chicago. Over this line upward of 90,000 persons travel weekly. Of these about 75,000 are suburban passengers, while about 15,000 are through passengers. Fifty per cent of this travel is between the hours of 5 p. m. and midnight. The sign, being so conspicuous on account of its size, brilliancy, etc., it is safe to say that practically all of these people have become acquainted with it.



ELECTRIC SIGN ON NEW YORK BUILDING OF WESTERN ELECTRIC COMPANY.

Of course the results such signs bring are not felt directly, but they are making the name of the concerns familiar to hundreds of thousands of people, and the indirect results greatly outweigh any that could be obtained by any other advertising expense equal to that made in erecting and maintaining these signs.

Beauty of design is now being studied by many concerns in the building of electrical signs. The display in New York on Broadway, between Twenty-third and Forty-sixth streets, known as "The Great White Way," is alone worth a journey of many miles to see, and is a feature of the great metropolis.

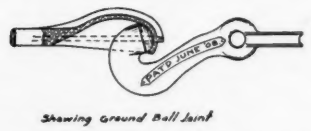


ELECTRIC SIGN ON A HAWTHORNE FACTORY BUILDING OF THE WESTERN ELECTRIC COMPANY.

High-Tension Drop-Out Span Protectors.

Where high-tension lines cross telephone or other circuits, it is essential that some method be provided for protecting the lower circuits from being subjected to dangerously high potentials in case the transmission-line wires should break.

Various methods of securing the desired result have been suggested. Some engineers require that where cross-overs occur, extra high poles be placed close together so that if a break occurs, the



HIGH-TENSION DROP-OUT PROTECTOR.

broken wires will not be long enough to reach down and make contact with the lower wires. In other cases the use of a grounded wire network or basket between the high-voltage and low-voltage wires has been required but this has not always proven entirely satisfactory.

Again there are many cases where it is not feasible to set two high poles close together, and the specifications for the grounded network often make it a very heavy and impracticable device, especially in cases where heavy wires are used on the transmission lines.

To meet the conditions actually found in commercial practice, the high-tension drop-out span protector, illustrated herewith, has been devised and a short explanation of its construction and use may be of interest.

The device consists of two parts, a fixed element secured to either the top or side of a standard insulator and a movable element connected to the transmission line and so arranged that by means of a ground ball joint, it makes positive contact with the fixed element.

It will be seen that with a span wire intact, heavy contact is maintained between the two elements of the connector, but upon breaking of the span wire, the movable element immediately drops and effectually disconnects, at the same time removing any danger of a live wire dropping down across the telephone or other wires which might be in position under the transmission wires.

The device is made in two types, No. 1 being known as a single-break protector and No. 2 as a double-break, the use of which is obvious.

These protectors are being placed on the market by the Central Electric Company, of Chicago, and are being used by some of the larger transmission companies.

Multiple Variable-Speed Electric Drive for Paper Machines.

The first Fourdrinier paper-making machine to be driven by individual electric motors on the various parts, has just been placed in operation by the Gould Paper Company, at Lyons Falls, N. Y. This is the first time that electric motors have been used to overcome the difficulties caused by the exacting speed requirements of a paper machine, and the results show that this method is far superior to any of the complicated belt, shafting and gear systems previously used to obtain similar results.

Absolutely unvarying speed of motors must be maintained in order not to break the pulpy web in its passage from section to section of the machine, and in the process of manufacture there are numerous difficulties encountered in maintaining a continuous sheet of paper on account of the inconsistency of the stock, the irregularities of the mechanism, the elongation of the web due to pressing, and the shrinkage in the drying process. Lastly, and very important, is the regulation of the driving mechanism so as to allow for the contraction and expansion of the sheet of paper in passing over the machine.

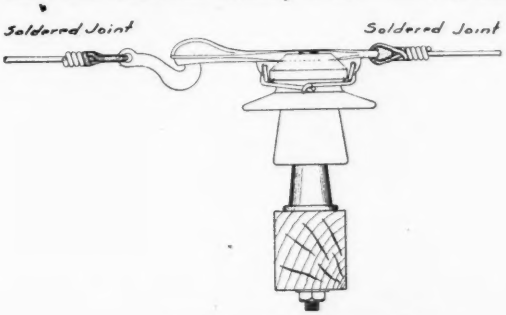
It is sometimes a matter of tedious adjustment on the part of the machine operator to get the "draw" of paper between the several sections, adjusted so that the web of paper will run the longest possible time without breaking, as there is a considerable loss of time and material when a break occurs.

Heretofore, uniform speeds in the various steps of the process have been obtained by two accepted methods. Both are very complicated systems of shafts, countershafts and friction clutches, with cone pulleys for the fine adjustments of speed, and either bevel gearing or long quarter-turn belts. These systems, in addition to their great complication, are open to several objections, chief among which are expensive mill construction, high cost of maintenance and danger to property and employes.

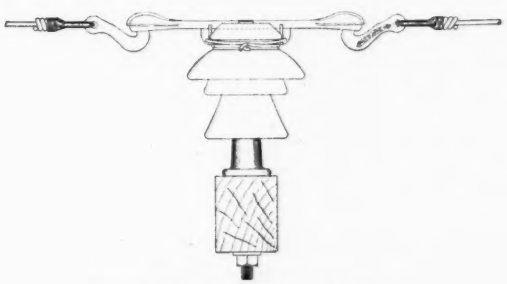
If constant speed were the only requirement, synchronous alternating-current motors might have been adopted to solve the problem. There is the added complication, however, that all classes of paper are not made at the same speed. At the Gould paper mill, for instance, newspaper is made at a high speed, while a heavy bag paper is manufactured requiring a very low speed. Besides this, the heavy starting torque required to start the couchers, presses, dryers and calenders makes the use of alternating-current motors impossible.

The system installed for the Gould Paper Company was worked out by the Standard Engineering Corporation of Wilmington, Del., and Philadelphia, Pa., assisted by the engineers of the Crocker-Wheeler Company of Ampere, N. J., who successfully handled the intricate electrical problems involved and furnished all the motors for the direct drive.

As is well known, it is difficult to build motors that can be adjusted to absolutely unvarying speeds, but all the exacting requirements have been met and the system can be operated at any speed to accommodate any kind of paper, after once being adjusted to uniform speed.



SINGLE-BREAK PROTECTOR.



DOUBLE-BREAK PROTECTOR.

Electrical Flux.

Electrical manufacture and insulation demands and some expensive lessons have taught the economy of knowing and purchasing good flux for electrical uses.

By measuring the resistance of two pieces of 0.04 wire, a foot long, fluxed with muriatic acid, with a corrected Wheatstone bridge, the resistance was determined as four ohms. These wires were broken apart and resoldered with Allen flux and the same bridge registered a resistance of only 0.013 of an ohm.

A mechanical test of fluxes was made recently in which three fine copper wires were cut in two and resoldered. The fluxes used were muriatic acid, a "next-best" flux and Allen flux, with the same amount of solder. The wires were then suspended, supporting weights of different sizes. The stress each joint withstood is noted in the following table:

Type of Joint.	Stress at which Wire Broke.
Muriatic acid	100 pounds
"Next-best" flux	142 pounds
Allen flux	204 pounds

Allen flux is manufactured in three forms—the soldering stick, a very handy form for open, fast work; the soldering paste, the soft form for hard-to-get-at work; and the soldering salts, a granular form made liquid by adding water, for cases where a liquid but not acid flux is desired by the solderer.

These products have been on the market sixteen years, are approved by the National Board of Fire Underwriters, specified and used by the United States government and specified by a large majority of electrical flux users. Samples can be obtained from the L. B. Allen Company, Incorporated, Chicago.

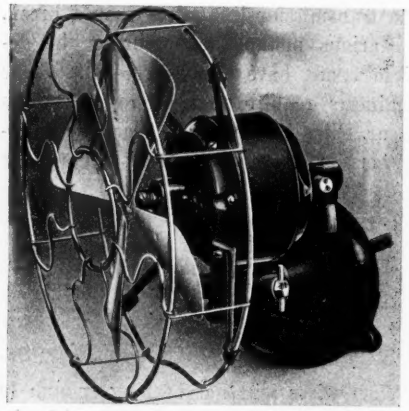
Bulletins of Modern Machinery.

A recent list of the publications issued by the Allis-Chalmers Company shows 187 bulletins and instruction books which that company has prepared, or has in course of preparation, relating to the products of its various departments, which include the manufacture of prime movers of every description, electrical apparatus for alternating and direct current, pumping machinery, mining machinery, crushing and cement-making machinery, flour-mill machinery, saw-mill machinery, etc. This information is indexed in a convenient manner and as a reference is valuable. The Allis-Chalmers Company's publications are illustrated by cuts of the most modern appliances and methods, and can be had on application.

"Peerless" Electric Fan Motors.

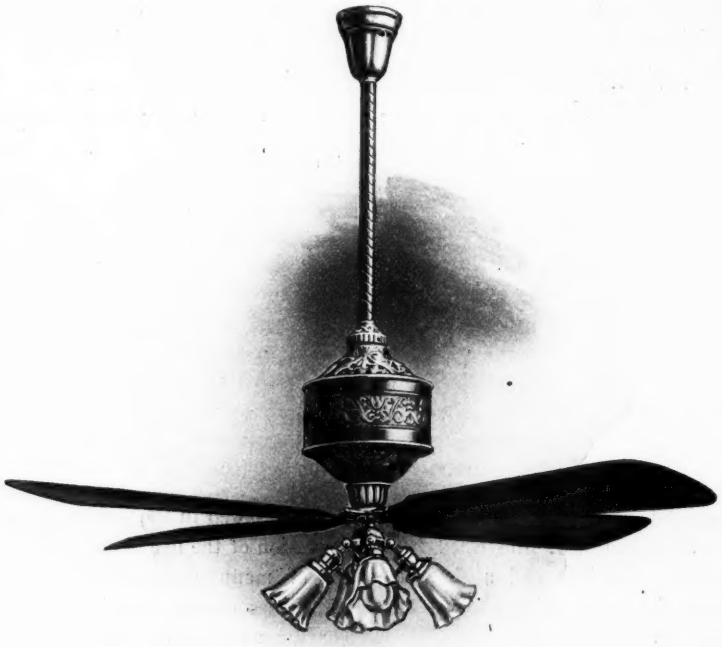
The direct-current fan motors that the Peerless Electric Company, of Warren, Ohio, has prepared for this year's demand are provided with many improvements of detail designed to keep this line of fans up to the best engineering practice. Some of the new features relate to the commutator construction and the use of rectangular carbon brushes, which must wear evenly and cannot turn so as to present a sharp edge to the commutator. Attention to the design of the fan blades has resulted in a minimum of noise. Desk and bracket fans are standard for 110 or 220 volts, but are also furnished for lower voltages for railway and storage-battery service or for any special voltage. Ceiling and column fans are supplied for 110, 170, 220, 250 and 500 volts regularly as well as for special voltages.

A special new offering this season is the Peerless universal desk and bracket fan, which is readily convertible from one position to the other while running without requiring any special tools. These fans can be turned in any direction and tilted up or down within forty-five degrees from the horizontal. The type GG fans are of swivel and trunnion design. Desk fans of this type can be changed to bracket fans by the use of a simple adapter. In the oscillating fan the oscillation is secured by a shifting vane located inside the guard. The fan body rotates on a ball bearing. Current is led to the fan through carbon brushes engaging collector rings mounted on the bearing shaft. In this way there is no possibility of the wires wearing off in consequence of the oscillating movement.



PEERLESS TYPE EE UNIVERSAL FAN.

The ceiling-fan motors are made with or without electrolier attachments and are generally provided with four blades of fifty-six-inch blades. This applies also to the column fans. Ventilating fans are also made by this company in various sizes and are equipped with either straight, Davidson or Blackman blades.



PEERLESS TYPE HH DIRECT-CURRENT CEILING FAN.

Folding Tungstoliers.

The Tungstolier Company, Schofield Building, Cleveland, Ohio, has developed a line of tungsten fixtures which constitutes one of the most important advances in increasing the use of the new high-efficiency incandescent lamps and renders available a line of lighting units which may be used for every conceivable class of installation.

The particular features of the new line of "folding tungstoliers" are the simplicity with which the fixtures may be made ready for use, and the durability and highly artistic arrangement for the assembled apparatus. The accompanying illustrations give a good idea of the method of displaying and making ready for use this apparatus.

THE ARMS FALL RIGIDLY INTO POSITION AND LOCK SECURELY.

In the first illustration the demonstrator is shown holding a four-light tungsten fixture all wired up at arm's-length. This shows all the room that the fixture takes up on a shelf and is a pointed commentary on the compactness and flexibility which obtains in handling, shipping and stocking. The fixture is complete, as thus shown, with no additional expense or time required for wiring or assembling. The metal work is composed of No. 22 gauge and the factory facilities are such that the highest grade of material is produced.

Turning over the fixture allows the arms to fall into position and they become very rigid. No iron pipe is used, as it is not needed, and the mechanism is of the greatest simplicity.

FOLDING TUNGSTOLIER, BOTTOM UP, AT ARM'S LENGTH.

LAMPING UP THE FOLDING TUNGSTOLIER.

Within the body each arm rests on two reinforced bearings which support it from above and below with a one-inch leverage. There is a small adjustment screw to true up the position of each arm.

To make an installation, all that is necessary is to provide the ceiling connection, and instead of climbing up a stepladder with the hands full of fixtures and tools, the tripod is first attached and then the complete fixture is coupled to the tripod by simply inserting a cotter pin.

In another line of folding tungstoliers for low-ceiling work a varying outlet is furnished which will permit of as much as a two-and-one-half-inch adjustment, the canopy of the fixture completely covering the outlet box. This ceiling connection can be made on an outlet box, gas pipe, insulating joint, tripod or hickey, and since the fixture hangs on a cotter pin its own weight rights it and there is no uncertainty concerning screw-threads. The socket is connected to the arm by simply hooking on and forming an anti-vibrating device to protect the tungsten lamp.

THE FIXTURE IS ATTACHED TO THE HOLDER BY A COTTER PIN.

The illuminating features of these tungstoliers have been scientifically designed and the lighting units are complete for whatever form of illumination they may be selected.

These folding tungstoliers are made in twenty styles at present.

Jandus Fans for 1909.

The Jandus Electric Company, Cleveland, Ohio, is placing on the market the following types of electric fans for 1909:

Direct Current.—Twelve-inch and sixteen-inch desk and bracket fans, of the swivel and trunnion type; twelve-inch and sixteen-inch desk and bracket fans, of the oscillating type; eight-inch desk, bracket and telephone booth fans.

Alternating Current.—Twelve-inch and sixteen-inch induction motor desk and bracket fans, of the swivel and trunnion type; twelve-inch and sixteen-inch induction motor desk and bracket fans, of the oscillating type; eight-inch desk, bracket and telephone booth fans.

Gyro Fans.—Twelve-inch and fifteen-inch ceiling and column type, direct current; twelve-inch and fifteen-inch ceiling and column type, induction motor alternating current.

Fig. 1 and Fig. 2 show the direct-current and alternating-current induction motor, desk and bracket fans, swivel and trunnion type. The swivel yoke is a novel feature and is made by forming two quarter-inch steel rods into a strong and rigid support for the motor body, thus eliminating all breakage, retaining at all times a pressure against the motor body and doing away with wing nuts and set screws.

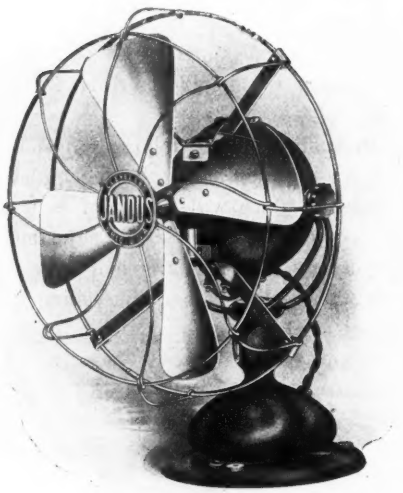


FIG. 1.—JANDUS DIRECT-CURRENT DESK AND BRACKET FAN, SWIVEL AND TRUNNION TYPE.

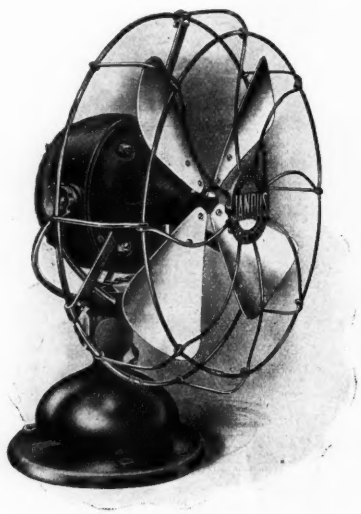


FIG. 2.—JANDUS ALTERNATING-CURRENT DESK AND BRACKET FAN, SWIVEL AND TRUNNION TYPE.

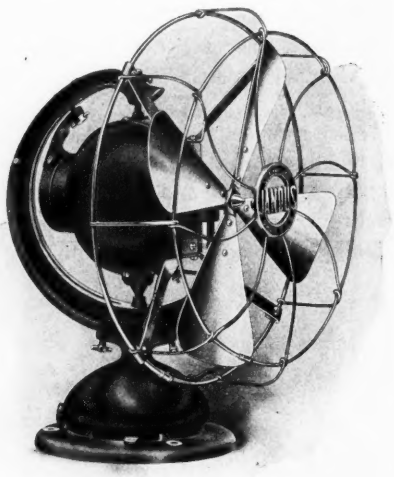


FIG. 3.—JANDUS DIRECT-CURRENT DESK AND BRACKET FAN, OSCILLATING TYPE.

Fig. 3 and Fig. 4 show the direct-current and alternating-current induction motor, desk and bracket fans, oscillating type. The "positive-drive" oscillating fan motor, manufactured by the Jandus Electric Company, is a radical departure from existing types, in that it neither employs the vane principle, nor is it actuated by a train of gears, but depends upon a simple form of differential gear for its angular displacement. The Jandus oscillating fan, as well as the swivel and trunnion desk fan, may be used either as desk or bracket fans without the use of an adapter.

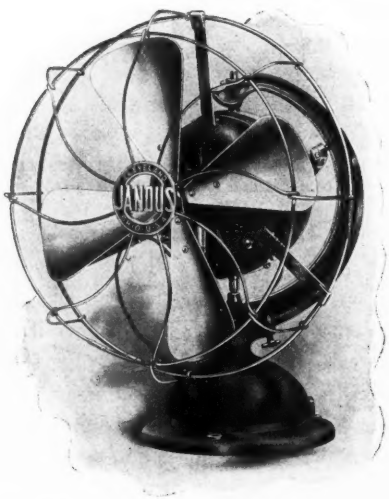


FIG. 4.—JANDUS ALTERNATING-CURRENT DESK AND BRACKET FAN, OSCILLATING TYPE.

The "Gyrofan" consists of two Jandus fan motors, pivotally mounted on a frame arranged to revolve about the vertical axis on a ball bearing. No current is utilized for the revolution of the fixture, which results from an angular adjustment of the motor shafts with respect to the vertical axis—in other words, the revolution depends upon the angle at which the two fan blades impinge upon the air. The quietly revolving fixture carries the rapidly rotating fans around at the rate of about ten revolutions per minute, throwing a strong whirling blast over a wide area and repeating it at any given point twenty times a minute.

Fig. 5 shows the alternating-current "Gyrofan," which is manufactured in twelve and fifteen-inch sizes for 110 and 220-volt circuits and for frequencies of twenty-five, forty, sixty and 133 cycles. Alternating-current, single-phase, self-starting induction motors are used.

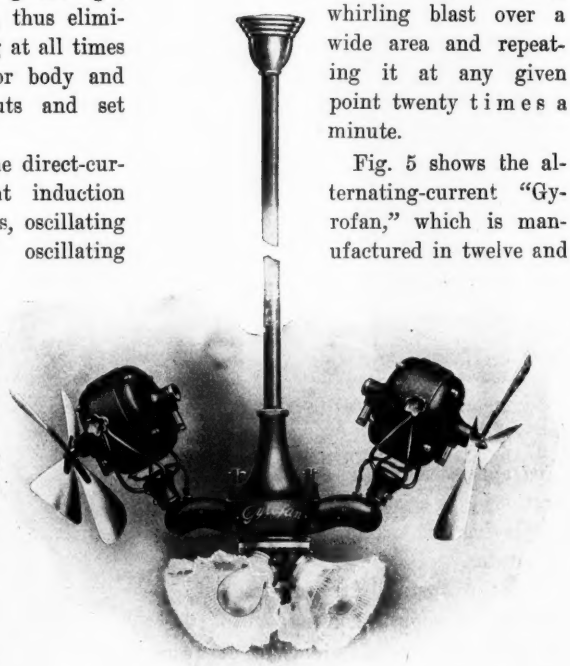


FIG. 5.—JANDUS ALTERNATING-CURRENT GYROFAN, INDUCTION MOTOR TYPE.

Current Electrical News

CONTINENTAL EUROPE.

(Special Correspondence.)

PARIS, FEBRUARY 20.—A new form of wave-controlled torpedo has recently been tried in France, and it appears that the first experiments made with it are very promising. The torpedo is built on the Creusot system, and during the trials was put through a series of evolutions maneuvred from apparatus located in a shore station. These experiments are being continued at present.

In the field of central stations and electric-lighting projects, the matter of the town lighting for Chalmont is being considered. There are two different companies applying for the rights, one of them being located at Grenoble. A company has been formed in the Calvados department for the purpose of operating the electric plants which now exist in the towns of La Haye, Vire and St. James, and it is expected to erect a new station in St. Lo. At Anor, in the north of France, the contract for the gas supply is soon to expire, and the question of using gas or electric lighting for the next franchise period is being debated for public and private lighting.

Budapest now has a new line of tramway running to the suburb of Erzsebetfalva in order to develop this region. The line is operated by the Budapest Electric-Tramway Company, having been opened for service recently. There is some talk of electrifying the rack-rail road, which runs to Schwabenberg, as it is proposed to have it taken over by the city. Plans are being drawn up for the electric lighting of the town of Bekes, Austro-Hungary, and among other projects in the same country I note the forming of a company for the electric lighting and water supply of the town of Sürmeg. The Hungarian Siemens-Schuckert firm has recently secured the contract for the electric lighting of Nagy-Koros. A. DE C.

GREAT BRITAIN.

(Special Correspondence.)

LONDON, FEBRUARY 20.—In a lecture before the Society of Arts dealing with recent progress in electric lamps and electric lighting, Leon Gaster, who will be remembered as having interested himself in the formation of an illuminating engineers' society, dealt at some length with the need of co-operation and standardization. At present, he said, lamp makers in Great Britain were fighting against each other, with the result that their lamps were frequently inaccurately stamped. Attention was drawn to what has been done in America in this connection and stress was laid upon the fact that the Boston Edison Company has not lost a "sou" in revenue as the result of the use of metallic-filament lamps, due to their illuminating engineering department.

The final upshot of the opposition of Scottish local authorities to the proposals of a company to supply electrical energy, using the Scotch railway tracks as a means for laying their mains, is that a resolution has been passed calling upon the Board of Trade to refuse the public supply of electrical energy without statutory powers. Of course, if the promoters of this scheme are able, as it is said they have been, to make arrangements with the railway companies to lay mains alongside their tracks, there would be no need to go to Parliament for powers, as no breaking up of the streets would be necessary, most large works being situated on the railway. Thus the existing authorities are deprived of any means of opposing. If, on the other hand, the new company is forced to go to Parliament, then the municipalities will be able to oppose and might even make good their case.

The Council of the Institution of Electrical Engineers has appointed P. F. Rowell, the present assistant secretary, to succeed Mr. Lloyd.

The introduction of the trolley omnibus system of electric traction into Great Britain has not gone forward so smoothly as seemed at first possible. Following on the decision of the Manchester and Liverpool corporations to abandon the idea, at any rate for the present, the matter is being constantly "referred back" at Dundee, where the question was first taken up, and it does not seem that it will make any appreciable headway there within a reasonable time. The deputation from Sheffield, which paid a visit to the Continent to inspect the installations at work there, is now preparing a report.

The London County Council has the right to call upon the electric supply authorities in the metropolis to provide pressure-testing stations. The construction of special stations for this purpose was felt to be unreasonable by the supply authorities, and it has now been agreed to facilities being afforded at the generating stations and substations, provided "pilot" wires are run to the distant parts of the network.

An interesting company has just got to work in the Durham District of England under the name of the Waste Heat and Gas Electrical Generating Stations, Ltd. The *modus operandi* is to concentrate the waste heat from the numerous coke ovens in the district and to turn it to useful account by driving electrical machinery. The electric power companies in the north-east of England, who are interested in the undertaking, find they can generate electricity more cheaply in this manner than in a steam-driven station. At present, therefore, the power companies have agreed to take in bulk all the electric power which the Waste Heat company can turn out. G.

EASTERN CANADA.

(Special Correspondence.)

OTTAWA, FEBRUARY 27.—The efficiency of the telephone for train dispatching has been so successfully demonstrated by the Canadian Pacific Railway, since it has been in operation between Montreal and Farnham, that its adoption on two circuits on the western lines of the road has been decided upon. The idea is to entirely dispense with the telegraph as the medium of operating trains.

The governor of Ontario has issued a proclamation bringing into effect the act to provide for the development of water-power at Dog Lake, near Port Arthur, Ont. The Hydro-Electric Power Commission will soon start work on the storage dam at the point where Dog Lake empties into the Kaministiquia River. This will equalize the flow of water to provide sufficient power for Port Arthur and other nearby towns that may require power.

There is a proposal to make use of the noted power developed by the great rise and fall of the tide in the Bay of Fundy. A company is applying to Dominion parliament for authority to harness the Fundy tide under the name of the Fundy Tide Power Company. To develop power, the company wants authority to construct dams across the mouths of many rivers and streams at the head of the bay in the provinces of New Brunswick and Nova Scotia and at the head of Cumberland Basin and the Basin of Minas.

The Montreal-Cobalt Power Company, which a number of Americans are backing, will, it is stated, within nine months be supplying the silver mines at Cobalt with electric power. The company will have 25,000 horsepower and will be in a position to supply energy within a radius of 100 miles, going as far south as North Bay, Ont. The company's works are being rapidly completed at the "Notch," some twenty miles from Cobalt, where the Montreal River and Temiskaming Lake meet. The rates will be much less than half the price at which steam-produced electricity is now being sold at the mines and towns in the district.

A new plan to dam the Long Sault Rapids, for power purposes, has been laid before the Dominion government. This proposition is made by the Long Sault Development Company, which made a proposition to the government two years ago for the same purpose. The new plan is to limit the height of the dam at any point the government will approve, and in addition the company offers to construct a canal on the American side and throw it open to public use. The new proposal is being considered by the government. W.

WESTERN CANADA.

(Special Correspondence.)

WINNIPEG, FEBRUARY 27.—John Tait, superintendent of the Canadian Pacific Railway telegraphs, with headquarters at Winnipeg, Manitoba, states that during the present year the company will build a number of new lines throughout western Canada. Several new copper circuits will be installed in addition to commercial and railroad wires along the extensions to be made by the railroad company this summer.

Sealed tenders will be received by Napoleon Tessier, secretary of the department of public works, Ottawa, until March 15, for wiring the public building at Dauphin, Man., now under construction. Specifications and all information may be obtained at the department.

The farmers of Wideawake, Saskatchewan, are organizing a

rural telephone system which will have connection with Yellow Grass, Weyburn, Milestone and other adjacent towns.

Until April 15, sealed tenders will be received by Magnus Peterson, secretary of the civic board of control, Winnipeg, Manitoba, for the supply of two testing transformers, one of thirty kilowatts capacity at 80,000 volts and one of 200 kilowatts capacity at 200,000 volts, as well as control equipment therefor. Plans and specifications may be seen at the office of F. E. Cambridge, city electrician, Winnipeg, and at the office of Smith, Kerry & Chace, Confederation Life Building, Toronto, Ontario.

A syndicate is seeking a franchise at Portage la Prairie, Manitoba, to distribute electric light and power and also construct an electric-car system. A. E. McPherson, attorney, is acting for the applicants, who are reported to be the Winnipeg Electric Company.

The Southern Alberta Railway has secured a franchise and will construct an electric street railway in Medicine Hat, Alberta, with branches to adjoining districts. For information address A. M. Grace, Medicine Hat, Alberta.

Orr Jarvis, Winnipeg, Manitoba, has been asked to make an offer for a franchise for an electric-light and power plant for Claresholm, Alberta.

The promised reduction in telephone rates on the government system in Manitoba has been announced. In view of the alleged surplus of over a quarter of a million dollars claimed by the government, subscribers all over the province are of the opinion that the reductions made are not sufficient. The opposition press points out that the apparent surplus shown is made by charging up unearned rentals, and in reality there is a deficit of some $50,000, without making allowance for depreciation of the system. In Manitoba there are some 21,000 phones under government operation, with long-distance lines extending all over the province. As far as the official list of reductions show, there is now a reduction made in the direct business rate of $50 per annum for Winnipeg subscribers, instead of which several new classes have been made by charging two cents per outgoing call. R.

IMPORTANT DEVELOPMENT.

(Special Correspondence.)

SOUTH BEND PLANT—The Indiana & Illinois Navigation and Power Company is the name of a new organization with $200,000 capital. The corporation is formed to improve the Kanka River between a point near South Bend to Momence for the creation of hydraulic power for the generation and transmission of electricity. A. J. Brunnel, one of the incorporators, will be in charge of the company's headquarters in this city. S.

CHICAGO'S SUBWAY OUTLOOK—Bion J. Arnold, consulting engineer for the city of Chicago in the traction rehabilitation, who also, as engineer to the New York Public Utilities Commission, has just reported that "there is no field in New York city for the construction of a comprehensive system of subways entirely with private capital unless the fare for the long-haul passenger is something more than the present five-cent fare, has declared that "what applies to New York certainly applies to Chicago. The city should build its own subway and lease the tube to the company or companies operating the street railways."

POWER FROM THE COLORADO RIVER AT MARBLE FALLS—Work has been started on the great dam to be erected across the Colorado River at Marble Falls, Texas. It is estimated that this dam, when completed, will produce over 10,000 horsepower. The power will be used to operate a cotton mill which has just been completed at a cost of $40,000. Other industries will be established later. The cost of the dam will be only about $250,000, on account of the use of a natural granite dam as the foundation. The structure is being erected by the Granite Manufacturing Company, of which E. C. Linsner of Marble Falls is at the head. The dam, which will be twenty-two feet high, will form a lake about ten-and-one-half miles long and from 1,000 to 2,000 feet wide. After the structure is completed, another dam will be erected at the lower falls, about two miles below the present development. D.

POWER DEVELOPMENT AT LLANO, TEXAS—The large dam across the Llano River at Llano has been completed. The structure was erected by Andrew J. Zilker, a capitalist of Austin. The dam is constructed of reinforced concrete, and a hard-red granite found in this locality was used as rubble. The structure is strongly reinforced by steel uprights and a heavy steel cable, two-and-one-half inches in diameter. The dam has the form of a horseshoe, with the apex downstream, instead of the usual shape, with the apex pointing upstream. This was done in order that a strong foundation of solid granite might be made use of. As the sand and rubble was gotten out of the bed of the river within 100 feet of the dam, the cost of this material was very small. The height of the dam is fifteen feet above the normal water mark. The power derived will be used to operate the local electric-light and power plant, ice factory, waterworks and flour mill, all owned by Mr. Zilker. Power will also be sold for other industries. D.

ELECTRIC LIGHTING.

(Special Correspondence.)

HASTINGS, MINN.—The ordinance granting the local electric-light franchise has passed its first reading. C.

WAHPETON, N. D.—The City Council is considering the installation of electrical machinery at the pumping station. C.

GRUNDY CENTER, IOWA—The local heat and lighting plant has been sold to John Calderwood, of Traer, Iowa, for $12,000. C.

PASADENA, CAL.—An ordinance has been issued providing for bonds amounting to $150,000 for improvements to the electric-lighting plant. A.

MINNEAPOLIS, MINN.—The Northern Heating and Lighting Company, of St. Paul, is seeking a franchise to supply the city with light and power. C.

RED LAKE FALLS, MINN.—The City Council has granted the Red Lake Falls Electric Light Company an extension of its franchise for five years. C.

ST. PAUL, MINN.—A bill has been passed in the State Legislature providing that trains on main lines must have a 1,500-candlepower head-light. C.

DUBUQUE, IOWA—The Farley & Loetscher Manufacturing Company will install a new power house at Eighth and White streets, at a cost of $25,000. C.

SPOKANE, WASH.—R. B. Brown, of Seattle, has filed an application for 10,000 cubic feet of water per second from the Yakima River, for power purposes. A.

GRUNDY CENTER, IOWA—John Calderwood, of Milwaukee, Wis., has purchased the electric-light plant for $12,000, and will take personal charge of it March 1. C.

SPOKANE, WASH.—Codd & McKensie, of Colfax, Wash., have declared their intention to build a power plant at the Great Falls of the Washtucna River. A.

MUNCIE, IND.—The Indiana Union Traction Company has contracted to light with electricity Selma, Yorktown, Normal City and several other villages along its line. S.

GEORGETOWN, DEL.—A movement is on foot to elect a new City Council, which will be in favor of substituting electric lights for the present gas-lighting system at Georgetown.

SEATTLE, WASH.—R. F. Chapman, representing the Peninsula Light and Power Company, has secured the contract for supplying power to the United States Navy Yards at Bremerton. A.

BRYSON CITY, N. C.—The Franklin Manufacturing and Development Company has been incorporated to do a general timber business, supply electric lights, etc. Capital, $50,000. L.

NEW RICHMOND, WIS.—A committee of the City Council, acting in conjunction with O. W. Mosher and the city electrician, is in the market for a new transformer of 150 kilowatts capacity. C.

MERIDIAN, IDAHO—F. M. Honsch, representing the Idaho-Oregon Power Company, has completed preliminaries for the right-of-way for the company's power line between this city and Boise. A.

ELDORA, IOWA—The electric-light company, at Eldora, is considering the installation of two 1,500-horsepower boilers to replace the three 800-horsepower boilers now in use, starting an all-day service September 1. C.

AZTEC, N. M.—The Eden Canal, Land and Power Company has purchased two acres of land in the vicinity of this city for the purpose of erecting a new electric-light plant. Active work on the construction began March 1. A.

RED WING, MINN.—The Red Wing Gas, Light and Power Company has been negotiating with the owners of the power plant at Eau Claire, Wis., to carry a line to Red Wing, at an estimated cost of from $50,000 to $100,000. C.

MINNEAPOLIS, MINN.—The Lake Harriet Electric Company, of which C. J. Gotshall is president, and C. L. Bostwick, secretary, has been organized to supply the Linden Hill district, a suburb of Minneapolis, with electric light. C.

PHOENIX, ARIZ.—Arrangements have been made by President Chas. S. Smith of the Old Dominion Copper Company at Globe, Ariz., for the installation of a 2,000-kilowatt power plant in the smelter powerhouse of that company. A.

THORNTOWN, IND.—Work on a waterworks system will commence as soon as a contract can be let. The plant will cost $50,000, and there is a possibility of the electric-light plant and the waterworks being combined and a heating plant added. S.

MONTEZUMA, IOWA—The Montezuma Electric Light and Power Company has been incorporated with a capital of $6,000 to install and operate an electric-light, power and heating plant. George W. Wiltse, John McDonald and others are the incorporators. C.

RICE LAKE, WIS.—Sewell A. Peterson and P. M. Parker have sold their dam site and franchise on the Red Cedar River to the Red Cedar Valley Electric Company. A concrete dam and power house will be built this spring and four more turbines installed. C.

REDONDO, CAL.—The Starr Wave-Motor Company lost its steel pier and 600 feet of approach during the high seas which prevailed recently. The steel pier and machinery cost upward of $100,000. The company has not declared its intention of rebuilding. A.

DOUGLASVILLE, GA.—An election has been called by the mayor and aldermen of the town of Douglasville to vote on the question of issuing $10,000 bonds for a municipal lighting plant. There are pending four applications to install private plants to supply light. L.

MONROE, N. C.—The Southern Power Company has secured a site and will begin immediately the erection of a substation for the distribution of electric power in Monroe. Several large manufacturing plants, it is understood, will be patrons of the company there. L.

CHATTANOOGA, TENN.— It is said that an electric line will be built during the current year from Chattanooga to Cleveland, Tenn., a distance of about twenty-eight miles. A survey was made two years ago, and right-of-way for the proposed line is now being secured. L.

EMPORIA, VA.—The Emporia Hydroelectric Power Company has been incorporated, with $200,000 capitalization, to operate an electric power plant. Among those interested are W. Samuel Goodwyn, president; G. B. Wood, vice-president, and W. F. Deal, secretary and treasurer. L.

SAN JACINTO, CAL.—Mr. Whittier, owner of the Hemet Dam, announces the expenditure of $1,000,000 in the near future on an electric power plant that he will install just below the dam. Electricity is to be generated for electric lighting and power purposes throughout the San Jacinto valley.

SPARTANBURG, S. C.—A bid for supplying power for lighting the city has been submitted to the Town Council by the Southern Power Company, of Charlotte, N. C., indicating that the company will be prepared to supply electric power to the local section within a few months. The advent of this company will give Spartanburg two competing companies. L.

ANTRIM, N. H.—The Goodell Cutlery Company is preparing to utilize the largest waterpower privilege available on the Contoocook River. A 500-kilowatt dynamo and a set of waterwheels will be set up to give 800 horsepower under an eighty-foot head of water. About $55,000 will be expended. Former Governor D. H. Goodell is president of the Goodell Company.

MARYVILLE, TENN.—The plant belonging to the Rockford Electric Light Company, which was destroyed by fire, will be rebuilt at once, states James L. Clark, manager of the company. The company sustained a loss of about $10,000, as no insurance was carried on the plant. At a meeting of the directors Mr. Clark was authorized to begin reconstruction immediately.

SPENCER, N. C.—Steps have been taken at a meeting of the Spencer Board of Trade to establish an electric-light and power plant in Spencer. The Spencer aldermen, Board of Trade and business men have taken hold of the matter and propose to erect a modern plant adequate for the needs of the town, and unless plans fail a plant will be installed at an early date.

MINNEAPOLIS, MINN.—The Northern Heating and Electric Company of St. Paul, has petitioned the City Council for a twenty-five-year franchise. If granted, it agrees to leave the determination of maximum and minimum rates to the Council, and to have five miles of work completed within eighteen months and eleven miles of work completed within three-and-one-half years after beginning work. C.

SEATTLE, WASH.—The City Council has passed a resolution providing for the erection of cluster lights on Broadway and North Broadway from East Pike to East Roy streets. At a recent meeting of the City Council an ordinance was introduced authorizing the city comptroller to advertise for sale negotiable bonds for the sum of $500,000 for enlarging and extending the municipal light plant. A.

HICKORY, N. C.—The Waterpower Electric Company, of Hickory, Col. M. E. Thornton, president, has perfected arrangements to take over the waterpower at Horseford Shoals, thus giving the company control of sufficient available power to furnish all possible needs. It is estimated that 10,000 horsepower of waterfalls on the Catawba River will be under consolidated control in this section. L.

MEMPHIS, TENN.—The Woodward Iron Company is putting in electricity at its ore mines on Red Mountain and the mines and plants of the company will be completely equipped with electric lights. The coal mines at Dolomite were wired last year. There is less danger in the ore than in the coal mines, but the electricity will be used in the former as a matter of convenience and greater facility.

ANSON, N. C.—A decision has been rendered in an equity case in the United States Circuit Court at Richmond, Va., refusing a petition filed by the legal representative of Mrs. Bettie Bridges, a large stockholder in the Rockingham Power Company, of Anson, N. C., asking that the present receivers of that company be removed. The receivership case involves water rights said to be valued at about two million dollars. L.

NEWPORT, WASH.—A. G. Smith of Spokane, Wash., general manager of the Panhandle Electric Railway and Power Company, has applied to the City Council of Newport for a franchise to operate an electric light, power and heating plant in this city. He also asks for an electric railway franchise, on which construction is to begin in April, from Priest River to Priest Lake, a distance of twenty-seven miles. A.

ST. PAUL, MINN.—Senator T. T. Elwell of Minneapolis has introduced a bill in the Legislature to enable the city of Minneapolis to exercise the power of eminent domain to acquire the property of the Electric Light and Gas Company of Minneapolis. Three disinterested parties are to be appointed commissioners by the court, with power to compel the production of the papers and books of the lighting companies.

FREMONT, OHIO—For two nights the city of Fremont was in total darkness, because of the damage done by the storm of February 19, which was the worst ever experienced in the city. All electrical power of every kind was shut off and newspapers depending on electricity were unable to get out their regular issues. Telephone, telegraph, lighting, power, street-car and interurban service came to a standstill, the town being entirely cut off from the outer world. H.

WENATCHEE, WASH.—When the water was turned into the new power plant of the Great Northern Railway Company, in Tumwater Canyon, near Leavenworth, the standpipe, 175 feet long and four feet in diameter, composed of half-inch steel, gave way as a result of the pressure. The cause of the disaster is not known, but it is thought to be the result of improper bracing. The loss is estimated at about $20,000 and the opening of the plant will be delayed two months. A.

PASADENA, CAL.—Bids will be received till March 23, 1909, for furnishing this city with material and equipment for a municipal light plant. The equipment includes: One surface condenser and equipment, one 750-800-kilowatt, three-phase, sixty-cycle, 2,300-volt engine-type alternating-current generator, together with a fifty-kilowatt, 125-volt belted exciter; one additional exciter, one vertical cross-compound condensing engine and one 750-800-kilowatt turbo-generator unit. A.

ORANGE, MASS.—The stock of the Orange Electric Light Company has been bought by W. G. Webber of Boston, who is the new president, with Edward C. Mason, treasurer and clerk. Mr. Hubbard, who has been secretary and treasurer of the company for several years, will remain as general manager. The Orange Electric Light Company was incorporated in 1888 with a capital of $45,000. It has enjoyed a steady growth, and has paid four per cent dividends on its stock for several years.

SAN FRANCISCO, CAL.—On the uncontested motion of the Knickerbocker Trust Company, of New York, George H. Whipple, an attorney of San Francisco, was appointed receiver for the Stanislaus Electric Power Company, and Vanderlynn Stow was, at the same time, appointed receiver for the Tuolumne Water Power Company, an affiliated corporation. It is understood that the receivership for the two corporations is preliminary to the absorption of them by the United Railways Investment Company. A.

BUCYRUS, OHIO—After voting bonds for the erection of the buildings and equipment of the municipal electric-lighting plant at Bucyrus, the court has granted an injunction restraining the city from issuing the bonds. As a result the City Council has opened bids for lighting the city by private enterprise, awarded a franchise, and signed a contract. F. C. Kingsbury, of Columbus, submitted the successful bid, the price being $74.50 per arc lamp on an all-night schedule or $69 per lamp on a moonlight schedule. The present company also submitted a bid, which Council refused to consider, holding it irregular. The new plant will be in operation within eight months. H.

HARTFORD, CONN.—The Connecticut River Company proposes to dam the Connecticut River just north of Windsor Locks, building an electric plant and dealing in waterpower and electricity. It will construct a new canal so as not to obstruct navigation. By the plans of the company an aggregate of 10,000 horsepower will be developed. Charles E. Gross, president of the Holyoke Waterpower Company, after securing a decree incorporated in the proposed charter of the Connecticut River Company preventing the backwater from reaching Holyoke, is willing that the power company should go ahead. No construction is authorized that will raise the water at Enfield dam above its present normal level.

ELECTRIC RAILWAYS.

(Special Correspondence.)

LOS ANGELES, CAL.—H. F. Vollmer has been granted a franchise for a double-track electric road on certain streets in this city.

SAN DIEGO, CAL.—The Point Loma Railroad Company has been awarded a twenty-five-year franchise for the building of an electric street railroad in this city.

OSWEGO, N. Y.—The City Traction Company of Oswego has been incorporated by C. D. Beebe, William Nottingham and Harold C. Beatty, with a capital stock of $550,000.

ST. PAUL, MINN.—It is proposed to extend the street-car line which now runs to Inver Grove, seven miles south of St. Paul, to St. Paul Park, two miles northeast of Inver Grove. C.

LOS ANGELES, CAL.—Sealed bids will be received by the City Council up to March 23, 1909, for a franchise for a double-track electric street railroad on stated streets in this city.

SEATTLE, WASH.—The Seattle-Everett Traction Company has been incorporated with a capital stock of $2,000,000 by H. R. Thompson, George Carson, I. N. Miller, R. G. Sharpe, C. F. Young, E. H. Worthen and N. W. Bolster. A.

SAN FRANCISCO, CAL.—A scheme to build another street-railway line to Market Street over Stockton by tunneling the hill between Sutter and Sacramento Street has been given a hearing by the Supervisors' Public Utilities Committee.

MISSOULA, MONT.—The Missoula Street Railway Company has been incorporated, with a capital of $100,000. J. R. Wharton, W. A. Clark, Jr., and W. M. Bickford, of Butte; Sidney R. Inch, of Missoula, and C. E. McBroom are the directors. C.

DES MOINES, IOWA—C. R. Keyes has applied to the City Council for a twenty-five-year franchise for an elevated railway track through the city for the Des Moines Elevated and Interurban Railroad Company, which is said to have a capital of $20,000,000. C.

SACRAMENTO, CAL.—George W. Peltier, of the Central California Traction Company, which line is now in operation between Stockton and Lodi, announces that the company intends building and completing before the end of the year its proposed line at Sacramento. A.

BOZEMAN, MONT.—The Gallatin County Electric Railway Company has elected the following officers: H. S. Buell, president; George P. Dier, vice-president; Chas. B. Anderson, secretary; George Cox, treasurer. As soon as weather will permit, work will be commenced on the line to Salesville. C.

TYLER, TEXAS—H. L. Norton, a capitalist of Boston, Mass., is interested in building an electric interurban railroad between Tyler and Jacksonville, a distance of thirty miles. The territory between these two towns is a rich agricultural region. The promoters will consider extensions to Rusk and Morrill after the proposed road is completed. D.

WICHITA FALLS, TEXAS—Work will begin soon on the interurban to be constructed by Kemp and Kell, between Wichita Falls and Lake Wichita, five miles south. The promoters of the line have obtained a franchise and have taken over the electric-light and water plant of the town, formerly owned by the Wichita Falls Water and Light Company. D.

CHICAGO, ILL.—The Chicago City Railway has won its suit against the county treasurer, securing a permanent injunction from Judge Honore against the collection of more than $255,887 as the tax for 1908. The amount which he sought to collect was $360,960, but the railway contended that he had included $7,000,000 bonds that were not issued.

TEMPLE, TEXAS—A franchise has been granted by the city of Temple to Max Ellser and associates, of New York, to construct and operate an electric street railway in Temple. Under the terms of the franchise, the work must begin within eight months and the line must be in operation within eighteen months. The franchise is for a period of thirty years. D.

SPRINGFIELD, ILL.—It is announced that on April 1 the Illinois Traction System will establish fast through service between Springfield and St. Louis. The run will be made in three hours, which is as fast as any of the steam road schedules between these cities. At first two trains will be run each way daily. The service will be de luxe in every respect and the equivalent of that of any railroad.

NEW ROCHELLE, N. Y.—After twelve years' delay, work has been started on the new four-track electric rapid-transit system at New Rochelle, which will extend from Portchester to New Rochelle. The road which is being built by the New York, Westchester & Boston Railroad is over the route of the old Portchester Railroad Company, and will pass through Portchester, Rye, Mamaroneck, Larchmont, New Rochelle, Mount Vernon and the Bronx Borough to the Harlem River. The stock of the company is controlled by the New Haven Railroad Company, and it is said the work will be pushed to completion. In the Bronx the company has already completed a large part of the road, at a cost of $1,000,000.

SALT LAKE CITY, UTAH—The Utah Light and Railway Company is planning to make improvements to its plant costing in the vicinity of $300,000. Plans are being made for ordering a second 3,000-horsepower motor-generator costing $35,000. Also an emergency plant is to be erected at the Jordan River, with steam power equal to one-half the total demands on the present plant. A.

CHICAGO, ILL.—Judge Grosscup has entered an order compelling the payment of interest due January 1 on $80,000 of the bonds of the Chicago and Milwaukee Electric Railway Company of Illinois, after hearing a report of Master in Chancery Booth holding the bonds to be valid. Creditors contended that the bonds were issued after the Illinois corporation had parted with its property, disposing of it to a new company.

JAMESTOWN, N. Y.—The cars of the Jamestown Street Railway and Chautauqua Traction Company will hereafter be operated by Niagara Falls power. A. N. Broadhead, president of the two companies, has signed a contract to take the power. By this action an expensive power plant in Jamestown is put out of action and more than $100,000 worth of machinery is relegated to the scrap heap. This is the first Niagara Falls power to reach Jamestown.

CHICAGO, ILL.—The Chicago Railways Company has determined to stop all negotiations looking to a merger with the City Railway Company until such time as the Chicago Railways Company has completed the rehabilitation plans and demonstrated that its earning power is greater than the City Railway. The Chicago Railways Company is not standing in the way of the merger, but holds that the terms proposed could not be accepted in justice to its security-holders.

NEWTON, IOWA—Steps for the complete electrification of the Newton and Northwestern line have been taken by the P. S. Loring & Sons Company of Boston, Mass., proprietors of the road. The line will be electrified from Fort Dodge Junction to Rockwell City, a distance of twenty-four miles. The work will begin this spring and the $90,000 which will be necessary to do the work has already been set aside. It is generally understood that the entire line is to be electrified ultimately.

BLUFFTON, IND.—Rudolph Schug, president of the Bluffton, Berne & Celina Interurban Railway Company, has announced that plans have been perfected to begin work on the line between this city and Berne in a short time. He says he is not discouraged because of the activity of those proposing to build from Bluffton through Geneva to Celina, but says the Berne line will be built even if the other is built. He says the finances have been secured and his road will go through. S.

NEW YORK, N. Y.—Following recommendations made by Bion J. Arnold, the consulting engineer of the Public Service Commission, the Interborough Rapid Transit Company will lay off the side-door car train making trial trips in the Subway, until certain changes are made for the safety of passengers. The doors will be fitted with soft-rubber bumpers, to avoid the possible catching of clothing in the jambs, and outside handles will be placed on the doors to enable the station guards to open them.

NORTHAMPTON, MASS.—The Northampton Street Railway Company of Massachusetts before the State Railroad Commission reports that wages, coal and supplies cost the company thirty-three per cent more than ten years ago. The operating cost per car-mile has advanced forty-five per cent. Attention is particularly called to the heavy charges for depreciation and ordinary replacements, together with enlarged accommodations and additional improvements required by the public or through legislation.

DES MOINES, IOWA—The first step for the complete electrification of the old Newton & Northwestern Railroad has been announced by J. S. Loring & Sons Company, of Boston, Mass., proprietors of the road. This year the line will be electrified from Fort Dodge Junction to Rockwell City, a distance of twenty-four miles. This work will be commenced this spring and completed during the summer months. The sum of $90,000, which is considered necessary to electrify the twenty-four miles, has been already set aside.

NEW MANUFACTURING COMPANIES.

SAN FRANCISCO, CAL.—The Specializing Hardware and Electric Company has been formed with a capital stock of $25,000 by S. J. Bigelow, J. H. Kahn and H. C. Thaxter.

LOS ANGELES, CAL.—The Perry Electrical Works has been incorporated with a capital stock of $100,000, by A. S. Perry, H. E. Hayden, Linda Perry, H. A. Hayden and Robert Marsh.

CHICAGO, ILL.—The Northern Equipment Company has been incorported with a capital stock of $20,000 by Charles M. Clark, Rudolph Blom and F. Cederberg, to manufacture and sell steam power and electrical appliances.

NEW PUBLICATIONS.

NATIONAL FIRE PROTECTION ASSOCIATION INDEX—The National Fire Protection Association, from the office of its secretary, 382 Ohio Street, Chicago, has issued a complete index to the subjects covered in the printed records.

THE CUYAHOGA VALLEY VIADUCT—The Cleveland Engineering Society has published separately, but as part of its transactions, the paper on "The Cuyahoga Valley Viaduct of the Nickel Plate Railroad," read before the society October 13, 1908, by George H. Tinker, bridge engineer of the N. Y. C. & St. L. R. R.

JOVIAN BULLETIN—The February number of the *Jovian Bulletin*, which is the monthly organ of the Order of Rejuvenated Sons of Jove, has for its frontispiece a large portrait of Mr. John W. Brooks, the Pluto of the Seventh Jovian Order. Mr. Brooks is well known as the genial general sales manager of Pass and Seymour, Solvay, N. Y.

ANNUAL REPORT OF THE LIGHTHOUSE BOARD—The annual report submitted to the Secretary of Commerce and Labor by the Lighthouse Board contains an account in considerable detail of the property and apparatus supervised by the board as well as complete maps of American waters, showing the disposition of lighthouses on the coasts, lakes and rivers.

A GUIDE TO THE CITY OF CHICAGO—The publicity committee of the Chicago Association of Commerce, for the double purpose of guiding and interesting visitors and instructing citizens, has completed the publication of an excellent and complete guide book to the city. The book lists and describes places of interest, transportation systems, public buildings and offices, hotels, restaurants, etc., the detailed and up-to-date description of the modern city of Chicago being preceded by a brief historical review of the Cook County region.

BULLETIN OF THE AMERICAN SCHOOL OF CORRESPONDENCE—The general bulletin, dated March, 1909, of the American School of Correspondence, Chicago, contains a detailed description of the extensive courses offered by this institution. Besides a college preparatory department, the complete curriculum includes a school of architecture and departments for instruction in civil, electrical, mechanical, steam and sanitary engineering. The list of 125 textbook writers and instructors contains a large proportion of names well known in their respective branches.

"AID TO SHIPPERS" is the title of a seventy-two-page book containing a quantity of information of value to all engaged in the export or import trade. The book is issued by Oelrichs & Company, of New York, for more than forty years the American representatives of the North German Lloyd Steamship Company, who by reason of long experience are qualified to advise. The table of foreign moneys with United States equivalents, together with weights, measurements, tariffs and customs requirements, will be found of great value. This book will be sent, postpaid, on request to Oelrichs & Company, Forwarding Department, 5 Greenwich Street, New York.

STERILIZATION OF DRINKING WATER BY OZONE—Siemens & Halske, the great Continental electrical manufacturers, who are capably represented in this country by Dr. Karl Georg Frank, with offices in the Hudson Terminal Building, New York city, have prepared an interesting catalogue on the subject of the isolated plants of its manufacture, for the sterilization of drinking water by means of ozone. Various types of laboratory, industrial, stationary and portable sterilizing plants are described, and some account is given in the pamphlet of the extent to which the electrical production of ozone is already used for water purification, for commercial, municipal and military purposes.

LABOR LAWS OF THE UNITED STATES—The twenty-second annual report of the Commissioner of Labor, recently submitted to the Secretary of Commerce and Labor and to Congress, has been printed and bound for distribution by the United States Government Printing Office. It is a large volume of 1,562 pages devoted to a compilation of the "Labor Laws of the United States," with decisions of the courts relating thereto. The first chapter of 118 pages contains digests and summaries of the Federal, state and territorial labor laws, and the second chapter, taking in the rest of the book, gives the full text of the more important laws. Of interest electrically are the Massachusetts provisions for the protection of employes of electric companies, and the Minnesota law for the examination and licensing of electricians.

ENGINEERING SOCIETIES.

ELECTRICAL ENGINEERING SOCIETY, M. I. T.—At the dinner and special meeting held by the Electrical Engineering Society of Massachusetts Institute of Technology, on February 23, an address was delivered by L. L. Elden, superintendent of the Edison Electric Illuminating Company, of Boston. Mr. Elden described the main features of the company's generating and distributing system, pointing out the methods used to insure continuity of service and contrasting the present plant with that of about a decade ago. He also pointed out the rapid growth of the system and its development in economy as well as size.

PERSONAL MENTION.

MR. E. E. HUDSON, formerly manager of sales of the Battery Supplies Company, Newark, N. J., has been made manager of sales of the primary battery department of the Edison Manufacturing Company.

MR. E. M. TRINKS, formerly constructing electrical engineer with the telephone and telegraph manufacturing firm of C. Lorenz, Berlin, Germany, has just returned to the United States, and is now general manager of the Radio Telephone Company, at 49 Exchange Place, New York city.

MR. H. M. LITTELL, assistant to the general manager of the Pacific Electric Railway Company, Los Angeles, Cal., will, in addition to his other duties, have charge of all matters pertaining to the maintenance of operated tracks and structures for the company. Mr. A. E. Roome has become superintendent of telephones, telegraphs and signals, and Mr. S. H. Anderson, electrical engineer, will assume charge of the bonding and thermit welding work.

MR. GEORGE WESTINGHOUSE has sailed for England on the Mauretania, to attend the wedding of his son to Miss Violet Evelyn Brocklebank at Ironton Hall, Holmrook, Lancashire. He will return in two weeks. Speaking of business conditions, he said: "The situation that exists in the steel industry at present will have several important results which cannot be discerned at this time. It can bring about a betterment of the general financial condition in that much money that is now tied up will find its way into circulation."

MR. FRED A. KREHBIEL, for many years chief mechanical engineer of the Arnold Company, has resigned this position to become treasurer and engineer of the Fuel Engineering Company, 1712 Marquette Building, Chicago. Mr. Krehbiel laid the foundations for his technical work while a student of mechanical and electrical engineering at Armour Institute of Technology and at Cornell University. Since graduating from the latter in 1901 he has been associated with the Arnold Company. He has made a particular study of boiler-room design with a view to economic operation, which enables him to handle authoritatively all problems that come to a consulting fuel engineer.

ELECTRICAL SECURITIES.

After many fluctuations, accompanied by one of the severest declines in prices witnessed since a year ago last October, the market resumed some sort of balance, with prices moving upward and closing at their best at the end of the week. The action of the steel companies in making reductions in prices of material precipitated the tumble, and adverse rumors concerning tariff changes and decisions against large corporations indicated a general readjustment. The apprehension concerning the latter, however, and in general, the week of inauguration dawned very hopefully for a continuance of improved conditions.

ELECTRICAL SECURITIES FOR THE WEEK ENDED FEBRUARY 27.

New York:	*Closing.*
Allis-Chalmers common	13
Allis-Chalmers preferred	40
American Tel. and Tel. Company	128¼
Brooklyn Rapid Transit	71
General Electric	154⅛
Interborough-Metropolitan common	14½
Interborough-Metropolitan preferred	40¼
Kings County Electric	123
Mackay Companies (Postal Telegraph and Cables) common	72
Mackay Companies (Postal Telegraph and Cables) preferred	70
Manhattan Elevated	145
Metropolitan Street Railway	28
New York and New Jersey Telephone	114½
Western Union	65½
Westinghouse Manufacturing Company	75
Boston:	*Closing.*
Edison Electric Illuminating	250
Massachusetts Electric	68
New England Telephone	132½
Western Telephone and Telegraph pref	78
Philadelphia:	*Closing.*
Electric Company of America	11⅜
Electric Storage Battery common	46½
Electric Storage Battery preferred	46½
Philadelphia Electric	11⅜
Philadelphia Rapid Transit	27⅛
United Gas Improvement	89¾
Chicago:	*Closing.*
Chicago Telephone	131½
Commonwealth Edison	108½
Metropolitan Elevated preferred	46
National Carbon common	85½
National Carbon preferred	118¾

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

AITKIN, MINN.—The Aitkin Telephone Company has been granted a twenty-year franchise.

CASHTON, WIS.—The Cashton Telephone Company has been incorporated by C. H. Cremer and others. P.

MOSIER, ORE.—The Mosier Valley Telephone Company has been incorporated with a capital of $1,200.

PINE RIVER, MINN.—The town of Pine River has granted a telephone franchise to James E. Gearey. P.

STAMFORD, NEB.—The Highline Mutual Telephone Company has been incorporated with a capital stock of $10,000.

RESACA, OHIO—The Resaca Farmers' Telephone Company has been formed by W. R. Bigelow and others with a capital of $10,000.

CEDAR RAPIDS, IOWA—The telephone managers of the Northeastern Iowa District Association met in convention at the Montrose Hotel. C.

REARDAN, WASH.—A franchise has been granted to the West Crescent Co-operative Telephone Company for the erection of telephone lines in this city. A.

DES MOINES, IOWA—The Miles & Bryant Telephone Company has been organized with a capital stock of $500 by Fred Naena, N. J. Millhaem and others.

BELLINGHAM, WASH.—The Pacific Telephone and Telegraph Company is soon to begin a series of improvements in this city at an estimated cost of $35,000. A.

THE DALLES, ORE.—The Mosser Valley Telephone Company has been incorporated with a capital stock of $1,200 by A. P. Batheam, J. W. McGregor and Lee Evans. A.

POWDERVILLE, MONT.—W. E. Barnard, mayor, is developing a plan to construct a telephone line from Frank O'Neill's ranch, a distance of thirty miles from Powderville. C.

NASHVILLE, TENN.—The Dowelltown Home Telephone Company, De Kalb County, has been formed, with a capital stock of $3,000, by B. W. Robinson, James Davenport, Herman Williams, M. B. Scott, C. B. White and others.

MERIDEN, IOWA—The Liberty-Meriden, West Lines, Mill Creek and Town Mutual of Meriden telephone companies have been combined as the Farmers' Telephone Company, of Meriden. J. E. Weise was elected president, and D. Holly, secretary. C.

TOLEDO, OHIO—The annual meeting of the Malinta Mutual Telephone Company, for the purpose of electing officers for the ensuing year and transacting other important business, will be held by the stockholders of the company at Malinta, Ohio, on March 4. H.

OSKALOOSA, IOWA—The representatives of ninety rural telephone lines in Mahaska County have agreed to use the lines of the Home Telephone Company for five years beginning April 1. This ends the controversy between the Bell and the Home companies. C.

KINSTON, N. C.—The Town Council of Kinston has taken preliminary steps looking to the holding of an election on a $75,000 bond issue, the proceeds of which it is proposed to use for building a municipal telephone system and for improving the city's water, lighting and sewerage plants, etc. L.

ATLANTA, GA.—W. G. Gentry, vice-president, has been elected president to succeed G. J. Hall. J. M. B. Hoxsey, the former auditor, was elected vice-president to succeed Mr. Gentry, with J. F. Brown, who was formerly general manager at Atlanta. The other officers and directors were re-elected.

JEFFERSON CITY, MO.—The Citizens' Telephone Company of St. Joseph has filed a certificate of increase of capital stock from $1,000,000 to $2,000,000. Thomas Gary of St. Joseph is the president of the company and Homer E. Scovern, secretary. Walter D. Dickey of Kansas City, Thomas Gary of St. Joseph and Dr. F. Rankin of St. Joseph are the directors.

MONTREAL, CANADA—Representatives of the provincial government of Saskatchewan have been in Montreal making overtures to the Bell Company for the purchase of its lines in Saskatchewan. That the Bell Telephone Company would probably sell if a price could be agreed upon, was the statement made by Charles F. Sise, president of the Bell Telephone Company of Canada.

BURNS, ORE.—A new telephone company, the Eastern Oregon Telephone and Telegraph Company, with John R. Jenkins, president; C. H. Voegthy, vice-president, and Ben Brown, secretary-treasurer, has acquired control of the M. L. Lewis lines in Harney and Crook counties, in all about 160 miles, and will build an exchange system in Burns and construct other lines in Harney, Malheur and Crook counties.

LOS ANGELES, CAL.—Carl Abrahamson, of Los Angeles, is engaged in his laboratory at San Diego in perfecting the details of a wireless torpedo appliance for the use of the United States Navy Department. Nearly a month ago Abrahamson conducted experiments with his invention, which, it is said, showed that he could propel and control submerged torpedoes by wireless telegraph.

TOLEDO, OHIO—As a result of the recent big sleetstorm the entire plant of the Citizens' Telephone Company, at Fostoria, Ohio, will be reconstructed. It will be practically rebuilt and plans are under consideration to introduce a number of modern details. The work will take about sixty days. C. E. Stinson, of Cleveland, chief engineer and general manager of the United States Telephone Company, will be superintendent. H.

PRAIRIE CITY, IOWA—The Rural & Four Cities Telephone Company, with headquarters at Prairie City, is about to complete the installation of its first exchange. The cities comprising the system will be Prairie City, Mitchelville, Altoona and Runnells. Underground and overhead cable is used in all town construction. The instruments are of the Homer Roberts manufacture, and in the rural districts the lockout system is being used. The installation is under the direction of Robt. L. Parker.

NEW YORK, N. Y.—On her last trip, the White Star liner Adriatic, from Southampton, reports that all the way from shore to shore she was in wireless communication with one side of the Atlantic. From February 17, sailing day, until February 23 she was in communication with the Marconi station at Clifden, Ireland. Then the operator picked up the station at Cape Cod. W. R. Cross of the Marconi Wireless Company made the voyage to watch the special receiving apparatus which had been installed. On his report it is probable that a special news service will be inaugurated on the vessels of the line.

TOLEDO, OHIO—James S. Brailey, Jr., of Toledo, who recently resigned his position as president of the Cuyahoga Telephone Company, of Cleveland, has been succeeded by E. G. Tillotson, of that city, who was also named as chairman of the board of the United States Telephone Company, Brailey being re-elected president of that concern. Charles A. Otis, Jr., Wm. L. Rice and Bascom Little were made new directors of the former concern and with James S. Brailey, H. A. Everet, E. W. Moore, B. Mahler, A. H. Bauer, N. C. McLeod and M. C. Harvey constitute the board. The position of general manager of the United States company was given to J. C. Boush, who has been assistant under Charles Y. McVey, who in turn was advanced to the position of general manager and vice-president of the Cuyahoga company. The United States Telephone Company, during the past week, increased its capital stock from $5,000,000 to $5,500,000. H.

DATES AHEAD.

Iowa Independent Telephone Association. Annual convention, Des Moines, Iowa, March 9-11.

Minnesota Electrical Association. Second annual meeting, Nicollet Hotel, Minneapolis, Minn., March 18-19.

Worcester Mechanical and Electric Exposition. Mechanics' Hall, Worcester, Mass., March 27-April 3.

Louisville Electrical Show. The Armory, Louisville, Ky., April 12-24.

Missouri Electric Light, Gas and Railway Association. Annual convention, Springfield, Mo., April 15-17.

Iowa Electrical Association. Annual convention, Cedar Rapids, Iowa, April.

Southwestern Electrical and Gas Association. Annual convention, Dallas, Tex., May.

American Electrochemical Society. Next meeting, Niagara Falls, Ontario, May 6-8.

Omaha Electrical Show. Omaha Auditorium, Omaha, Neb., May 6-15.

American Association of Electric Motor Manufacturers. Annual convention, Hot Springs, Va., May 17-20.

Association of Edison Purchasing Agents. Annual convention, Atlantic City, N. J., June 1-4.

National Electric Light Association. Annual convention, Atlantic City, N. J., June 1-4.

American Railway Master Mechanics' Association. Annual convention, Atlantic City, N. J., June.

Master Car Builders' Association. Annual convention, Atlantic City, N. J., June.

Ohio Electric Light Association. Annual convention, Toledo, July 13-15.

National Electrical Contractors' Association. Annual convention, Toledo, Ohio, July 21-23.

INDUSTRIAL ITEMS.

THE CENTRAL ELECTRIC COMPANY, Chicago, is distributing a new bulletin descriptive of Opalux shades and reflectors. Opalux is an entirely new line of shades especially designed for use with tungsten lamps. A copy of this bulletin will be sent upon request.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has recently issued a booklet, No. 3701, in which are listed and illustrated the company's snap-switches, both indicating and non-indicating, flush switches of the rotary and push-button types and pendent and ceiling switches.

QUEEN & COMPANY, INCORPORATED, Philadelphia, Pa., have prepared in circular form a list of the high-grade apparatus and instruments of their manufacture. The sales organization of the company is divided into five departments dealing respectively with optical instruments, draughting and engineering apparatus, physical and electrical apparatus, meteorological instruments and chemical apparatus.

THE HARVARD ELECTRIC COMPANY, 66 West Van Buren Street, Chicago, and 136 Liberty Street, New York city, manufacturer of electrical specialties, has issued a new catalogue, No. 17, descriptive of a part of the many electrical necessities made by the company. This catalogue is the forerunner of a complete new series of printed matter illustrating Harvard electrical specialties.

THE FEDERAL ELECTRIC COMPANY, Chicago, which opened its New Orleans office January 15, made the record of putting up about 100 electric signs between that date and the opening of the Mardi Gras Carnival. This included the large "Welcome" sign, which did duty both for the reception to President-elect Taft and for the carnival. The New Orleans branch was opened up by M. H. McClain, who is manager of the local office.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has issued bulletins Nos. 110 and 112, relating, respectively, to the operation of Chloride Accumulators in connection with remote-control oil switches, and in iron and steel mills. The latter pamphlet gives regulator circuit diagrams, in addition to a detailed description of the applications of the batteries as auxiliary sources of power during accident or shutdown of prime movers.

THE DUNCAN ELECTRIC MANUFACTURING COMPANY, Lafayette, Ind., in its bulletin No. 8 gives a general description of the Duncan integrating watt-hour meter for direct-current service. This meter embodies the patented visual bearing, fireproof binding posts, non-twisting brushes, low temperature-coefficient resistance, and switch method of compensating for friction and vibration. The bulletin contains instructions for reading and testing meters.

THE WEBER GAS ENGINE COMPANY, Kansas City, Mo., whose affairs are now in the hands of George T. Moore, as receiver, is continuing to book orders and turn out the products of its works, reporting that all its shops are running full time. During the temporary arrangement given the company to readjust its affairs and reorganize, the concern is desirous of securing an uninterrupted business prosperity and holds itself in readiness to serve customers in every way consistent with good business policy.

THE CHARLES L. KIEWERT COMPANY, Milwaukee, Wis., offers some interesting illumination data from Aurola and Alba flaming-arc lamps. The Aurola, provided with inclined carbons, is designed to throw the light downward, while the vertical-carbon arrangement of the Alba lamp gives a wide distribution. An example of the use of Alba flaming-arc lamps for economical and uniform street lighting, shows how a power consumption of 1,176 watts lights up a street block 400 feet in length, securing, with an expenditure of 2.94 watts per lineal foot, a mean illumination value of 0.56 candle-foot.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., has brought out an iron-clad telephone set for use in mines and other places where the climatic and moisture conditions are severe. In this instrument no coils are exposed, all wires are insulated in oil-soaked silk, and the door is made to close tightly against a rubber gasket. Complete particulars about this No. 890 mine telephone and several other types for inside use, and switchboard and construction materials, are given in the Stromberg-Carlson twelve-page bulletin No. 1000, sent on request.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has made "Gas Engines" the title of Bulletin No. 1063, issued for the purpose of exploiting the vast fields of gas-engine power service and the consequent economies of this form of prime mover. With gas-engine-driven units, fuel economy is a distinguishing characteristic, resulting in a delivery at the engine shaft of not less than sixteen to twenty per cent of the theoretical energy contained in the fuel. The Allis-Chalmers Company has equipped some of the largest gas-engine plants in operation, and guarantees economy from the coal pile to the switchboard.

M. B. BARR, of Toledo, Ohio, who has been in charge of the Warren Electric Manufacturing Company, for the trustee under the bondholders, was appointed special master of the property by Judge Reed at Sandusky, this week, under bond of $25,000. The appointment followed an effort on the part of certain secured creditors to have a receiver appointed. The American Bank, as trustee, opposed a receivership and its contention was sustained by the court, who appointed a special master instead for the purpose of getting the property under control where it could be advantageously sold and preserve the business in the meantime. It was rumored that a company headed by Cleveland capitalists will be formed to take over the property. The bankruptcy proceeding pending before Referee Claude DeWitt has been postponed and will probably not be heard for several weeks. An effort is being made to concentrate all the litigation now pending in various civil courts into one proceeding in the United States District Court at Toledo. H.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) February 23, 1909.

912,985. ELECTRIC HEATING DEVICE. Christian Aalborg, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed June 8, 1907. Consists of a number of current-conducting fluid-containing tubes and an insulating block in which the tubes are seated at each end.

912,992. STATION INDICATOR. Thomas R. Clark, Bradford, Pa. Filed May 1, 1908. The controlling mechanism for an indicating web includes an electromagnet and contacts in a circuit having portions located on the opposite faces of the web.

912,994. ELECTRIC HEATING APPARATUS. Frank Conrad, Swissvale, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed June 8, 1907. Similar to No. 912,985; the tubing is of helical form and connected at opposite sides with pressure heads, but insulated therefrom; the ends of the tubing have carbon tips to resist electrolytic action.

912,995. ELECTRIC-MOTOR-CONTROL SYSTEM. William Cooper, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed April 10, 1905. A selective controlling switch for a two-motor car is arranged so that one motor can be cut out without interfering with the normal operative control of the other.

913,016. ELECTRIC LAMP. Isador Ladoff, Schenectady, N. Y. Filed November 28, 1904. In combination with a pair of electrodes, between which an arc may be formed, is an open mesh mantel of rare earth oxides disposed so as to surround the arc and to be heated thereby.

913,017. DYNAMO-ELECTRIC MACHINE. Benjamin G. Lamme, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed August 2, 1906. Renewed July 3, 1908. The stationary ring-wound armature has a short-circuited secondary winding outside of the ring winding for preventing magnetization of the supporting frame when the ring winding is energized.

913,024. CLAMP FOR ELECTRICAL AND OTHER FIXTURES. William M. Meacham, Oak Park, Ill. Filed January 28, 1905. A clamp plate for insulating bushings has an aperture for the bushing and integral spring teeth with sharp edges forming part of the edge of the aperture.

913,041. FIRE-PROTECTION-SIGNAL SYSTEM. James G. Nolen and John E. Shepherd, Chicago, Ill.; said Nolen assignor to said Shepherd. Filed March 20, 1905. A diaphragm in a fluid-containing receptacle of a fire-extinguisher system is connected with an electrical signal-transmitting device.

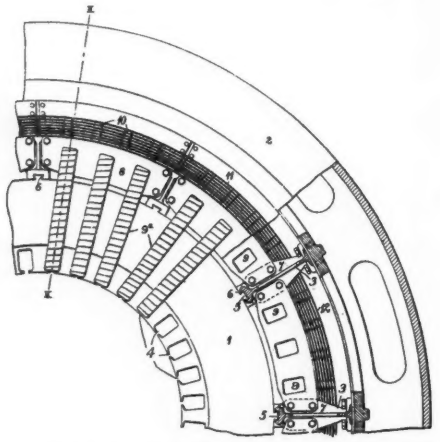
913,045. SPARK PLUG. Henry F. Parker, Montclair, N. J., assignor to Youle T. Frazee, Montclair, N. J. Filed December 1, 1906. A movable ball is adapted to make contact between a central rod and a cylindrical terminal.

913,048. ADVERTISING DEVICE. James W. Phelps, Detroit, Mich. Filed March 9, 1908. Clamped to an electric-light fixture is a transparent plate bearing advertising matter.

913,052. ELECTRIC TIME SWITCH. William E. Richter, Albuquerque, N. Mex. Filed February 4, 1908. A clock-controlled switch is operated by a sliding element.

913,053. ELECTRIC TRAP. George S. Riggs, Mable, Oregon. Filed March 24, 1908. An animal entering the trap steps upon plates of opposite polarity, one of which is pivoted so that its weight causes it to close the circuit of a motor operating an arm that sweeps the carcass from the plates.

913,060. ELECTRICAL APPARATUS. Otto Schaumberg, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed June 8, 1907. The upper and lower ends of an oil-containing transformer case constitute expanding chambers connected by a number of tubes.



913,017.—AUXILIARY WINDING FOR RING ARMATURE.

913,080. RINGING KEY. Klas Weman, Buffalo, N. Y. Filed July 10, 1907. Combined with sets of contact springs is a slotted tube having a serrated edge, a plunger reciprocable and rotatable in the tube, a head formed on the plunger adapted when the latter is depressed to operate the same set of contact springs irrespective of the angular position of the plunger.

913,081. CONTACT FOR ELECTRIC CONTROLLERS OR SWITCHES. Alfred White, Sunderland, England. Filed September 10, 1908. A reversible and renewable contact piece adapted to be secured to the finger or carrier by a screw has wings or shoulders for contacting with the controller drum.

913,086. CIRCUIT-CONTROLLING INSTRUMENT. George M. Willis, Chicago, Ill. Filed May 17, 1907. On the front of the instrument are several two-point switches for adjusting the needle contacts.

913,103. DEVICE FOR USE IN MAKING ARMATURE COILS. John F. Card, Three Rivers, Mich., assignor to Sheffield Car Company, Three Rivers, Mich. Filed October 16, 1908. Comprises a pair of end plates and a pair of oppositely facing coil holders, one of which is secured to the end plates and the other is movable.

913,104. UNDULATING-CURRENT APPARATUS. Fred Cedergren, Hammond, Ind., assignor of one-half to Frank S. Betz, Hammond, Ind. Filed October 7, 1907. Consists of an electromagnet with an oscillating armature operating a commutator so as to cause reversals of current in the circuit.

913,105. ELECTRIC-CURRENT INDICATOR. Franklin N. Conant, Newburyport, Mass., assignor to Chase-Shawmut Company, Newburyport, Mass. Filed January 11, 1907. An insulating case is provided with an aperture on its side, metallic caps on its ends, and an incandescent lamp and socket inside connected with the metallic caps.

913,122. TROLLEY RETRIEVER. Thomas R. Gabel, Los Angeles, and Alfred L. Eacrett, Hollywood, Cal. Filed February 18, 1908. A vertical guide on the dashboard of a car has a casing slidable thereon and containing an automatic reel for the trolley rope.

913,155. TROLLEY-WIRE CONNECTION. George S. Pannebaker, Lewistown, Pa. Filed September 23, 1908. The ends of the wires are secured in J-shaped wire-receiving grooves with a filling piece connecting the wire sections at the bottom.

913,160. ELECTRICAL CONNECTION. George H. Pride, New York, N. Y. Filed April 17, 1907. A socket is provided with a movable member adapted to enter it and to act as a barrier in precluding both insertable wires from engagement with a number of contact strips.

913,168. TROLLEY-WHEEL SHIELD. Alice A. Roth, Buffalo, N. Y. Filed March 23, 1908. Shielding wheels are arranged on opposite sides of the trolley wheel.

913,169. DISTRIBUTER. Walter H. Sanders, Orange, Mass. Filed June 11, 1907. A distributor for a multi-cylinder gas engine comprises a shell with a number of contacts closed intermittently.

913,180. TEMPERATURE ANNUNCIATOR. Nehemiah D. Wyman, Montclair, N. J. Filed May 14, 1907. One terminal of a circuit, including an annunciator or alarm, projects into the thermometer tube above the bulb; a number of other contacts project into the tube above, any of which may be connected with the other side of the circuit.

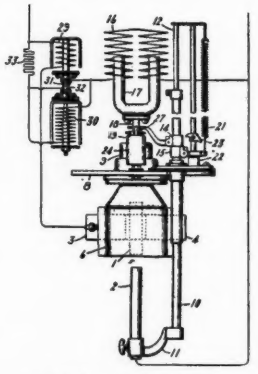
913,183. TELEGRAPH TRANSMITTING MACHINE. John C. J. Alderson, El Casco, Cal. Filed September 4, 1906. A vibrator constituting one terminal of a circuit has a plate slidably mounted on rods and adjustably connected to the vibrator for regulating its vibration.

913,209. ARC LAMP. Cromwell A. B. Halvorson, Jr., Lynn, Mass., assignor to General Electric Company. Filed March 7, 1907. One of the electrodes is permitted to separate by gravity from the other to strike an arc, a dash pot allowing the initial arc-striking movement to be free and the remainder of the movement retarded.

913,212. INSULATOR MOLD. Chauncey C. Johnson, Scranton, Pa., assignor of nine-twentieths to John A. Watson, Pittston, Pa. Filed September 14, 1908. A plunger is mounted within guides having oppositely disposed longitudinal grooves and a spacing tongue, oppositely disposed core sections being slidably mounted within the grooves.

913,240. ROLLER-BEARING TROLLEY. William H. Sheasby, Los Angeles, Cal., assignor to The Antifriction Journal Box Company, Los Angeles, Cal. Filed February 28, 1906. The trolley is provided with a bearing sleeve, rollers outside the sleeve, and a pin and insulating tube around the pin inside the sleeve.

913,242. AUTOMATIC MUSIC-PLAYING ATTACHMENT FOR PIANOS. Irving B. Smith, Philadelphia, Pa., assignor to Electrelle Company, Philadelphia, Pa. Filed August 29, 1905. Comprises electrically-controlled means located in the upper part of the piano case for actuating the hammer action.



913,209.—ARC LAMP.

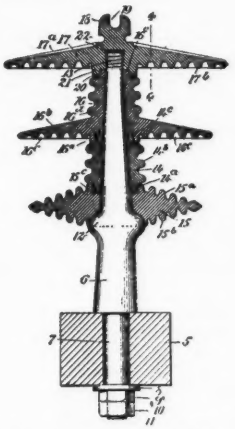
913,264. CABLE TERMINAL. Frank B. Cook, Chicago, Ill. Filed June 22, 1908. A cast-iron box is divided into front and rear portions for the aerial and cable conductors respectively, the latter passing through hollow binding posts in the partition and being fastened on its front.

913,283. SYSTEM OF ELECTRICAL CONTROL FOR MOTOR VEHICLES. Emil Gruenfeldt, Cleveland, O., assignor to The Baker Motor Vehicle Company, Cleveland, O. Filed January 23, 1908. Combined with the series-motor system described above is a subdivided storage battery that can be connected in parallel or series to get a wider range of speeds.

913,299. APPARATUS FOR MARKING CHECKS. Charles H. Marston, Reading, and Henry H. Cummings, Newton, Mass.; said Cummings assignor to said Marston. Filed August 7, 1908. An adding-machine printing couple is driven by an electric motor through a clutch under the control of the operator.

913,308. ELECTRIC ARC LAMP. William R. Ridings, Stretford, England, assignor to Westinghouse Electric and Manufacturing Company. Filed February 20, 1904. There is provided a relay magnet in series with the electrodes, a shunt feeding magnet and a separate shunt relay magnet operated by the former for cutting out the feed magnet during normal operation of the lamp, and means operated by the last-named magnet for cutting in the feed magnet when the resistance in the electrode circuit becomes abnormally great.

913,309. ELECTRIC SIGN. Bert E. Salisbury, Syracuse, N. Y. Filed September 16, 1907. Contains duplex receptacles with the terminal connections close together and lamp-receiving sockets on each side of the sign.



913,439.—DISC INSULATOR.

913,363. SYNCHRONIZING MEANS FOR ELECTRICAL APPARATUS. Albert C. Crehore, Yonkers, N. Y. Filed July 17, 1903. In combination with synchronous telegraphic apparatus is an alternating-current motor with a controlling relay in a line, including telegraphic apparatus, the relay being operated without disturbing the operation of the telegraphic equipment.

913,372. MEANS FOR SIGNALING OR EFFECTING OPERATIONS BY MEANS OF SOUND VIBRATIONS. John Gardner, Knott End, near Fleetwood, England. Filed May 4, 1907. Sound signal-receiving apparatus for effecting multiple control at the receiving station comprises two or more differently tuned resonators with microphonic contact devices mounted upon them and located in normally closed circuits that contain devices having movable parts to effect the desired controls.

913,383. CIRCUIT CONTROLLER. Samuel Holland, Park River, N. D., assignor of one-half to Thomas Catherwood, Park River, N. D. Filed December 11, 1907. A distributer for gas engines contains contact pins in a tubular casing engaged by a contact roller operated by a wrist pin.

913,390. ELECTRODE FOR GAS ELEMENTS. Ernst W. Jungner, Kneippbaden, Norrköping, Sweden. Filed May 13, 1907. In a galvanic gas element there is an electrode of carbon of such high porosity as to be incapable of retaining such a quantity of electrolyte as would fill its pores.

913,415. METHOD OF OPERATING ALTERNATING-CURRENT MOTORS. Ralph D. Mershon, New York, N. Y. Filed January 25, 1904. The method of varying the speed of a motor consists in making the change from one number of poles to another on a portion of the motor and carrying on such change progressively on successive portions until all the motor has been changed.

913,419. INSULATING TROLLEY-WIRE HANGER. Leo W. Moran, Grafton, O. Filed February 7, 1908. Consists of three pieces, comprising separate upper and lower metallic members having corresponding cup-shaped sockets on their inner sides and an insulating stem joining them.

913,430. METHOD OF PRECIPITATING METALS ELECTROLYTICALLY. Arthur Ramén, Helsingborg, Sweden, assignor to Helsingborgs Kopparverks Aktiebolag, Helsingborg, Sweden. Filed August 27, 1906. The process consists in leaching calcined ores, electrolyzing the leachings obtained, and during the electrolysis maintaining a solution of ferrous salts in proximity to the anode.

913,432. ELECTRIC-CORD RETRIEVER. William O. Rew, Eureka, Cal. Filed March 17, 1908. A reel for an electric cord consists of a pair of discs, a sleeve connecting them, thimbles set in the centres of the discs with laterally projecting nipples having means for attaching the electric wires thereto.

913,437. AUTOMATIC STARTER FOR CONTINUOUS-CURRENT ELECTROMOTORS. Gustav A. Schoeller, Mülheim-on-the-Ruhr, and Hermann Sundhausen, Essen-on-the-Ruhr, Germany, assignors to Fried. Krupp, Aktiengesellschaft, Essen-on-the-Ruhr, Germany. Filed March 12, 1907. Combined with the starting resistances is a shunt about the same, a maximum-current solenoid controlling the shunt circuit, and a starting solenoid for cutting out the resistances, its circuit being closed by the maximum-current solenoid.

913,439. DISC INSULATOR. Louis Steinberger, New York, N. Y. Filed November 27, 1905. Comprises a number of superposed corrugated discs, provided with means whereby they may be detachably locked together independently of any means for supporting them.

913,451. TELEPHONE-EXCHANGE SYSTEM. Garrison Babcock, Rochester, N. Y. Filed July 7, 1905. Means are provided whereby the receiver is irresponsive to transmitted currents and responsive only to received currents.

913,453. SPARK PLUG. Clinton Bateholts, Pittsfield, Mass. Filed May 4, 1908. An annular externally screw-threaded metallic shell has a terminal extension at its inner end and an electrode rod arranged axially within it.

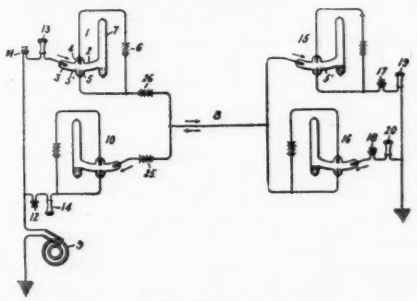
913,480. AUTOMATIC SWITCH AND STAND FOR PRESSING-IRONS. Frank E. Emery, New York, N. Y. Filed March 27, 1908. A switch on the stand is adapted to be operated by and to engage contacts on the pressing-iron, an indicator showing whether the switch is open or closed.

913,481. AUTOMATIC ELECTROMAGNETIC SWITCH AND STAND FOR PRESSING-IRONS. Frank E. Emery, New York, N. Y. Filed August 24, 1908. An electromagnetically operated switch adapted to open and close the circuit for heating the pressing-iron is controlled by a self-opening switch that is mechanically operated by the iron.

913,493. ALARM DEVICE FOR GUN TURRETS. John L. Hall, Schenectady, N. Y., assignor to General Electric Company. Filed May 20, 1908. Contacts governed by the elevation of the guns control an alarm circuit.

913,504. DOOR HINGE FOR ELECTRICAL RECEPTACLES. William W. Jones, Bridgeport, Conn., assignor to The Perkins Electric Switch Manufacturing Company, Bridgeport, Conn. Filed October 30, 1908. The door has an undercut recess and tranverse groove with a grooved hinging plate in the recess and a hinge pin passing through the grooves of the door and plate and securing them together.

913,282. METHOD OF CONTROL FOR MOTOR SYSTEMS. Emil Gruenfeldt, Cleveland, O., assignor to The Baker Motor Vehicle Company, Cleveland, O. Filed January 23, 1908. A series-wound motor is changed from a low voltage to a comparatively high voltage by changing the field windings from a parallel to a series relation, breaking the low-voltage connections and then making the high-voltage connection while the windings are in series.



913,521.—MULTIPLEX TELEPHONY.

913,508. ATTACHMENT FOR GRAPHOPHONES. Hanson C. Kelly, West Burlington, Iowa. Filed June 17, 1908. Consists of a magnet supported in the rear of the stylus for directly gathering up the particles of metal from the record.

913,512. STARTING DEVICE FOR ELECTRIC MOTORS. Charles D. Knight, Schenectady, N. Y., assignor to General Electric Company. Filed January 26, 1907. A starting box is provided with automatic low-voltage release, an automatic overload circuit-breaker arranged to be tripped as the arm returns to starting position, and means for preventing the movement of the arm toward running position when the circuit-breaker is open.

913,521. MULTIPLEX TELEPHONY. Marius C. A. Latour, Paris, France, assignor to General Electric Company. Filed May 27, 1905. At each end of the line are two rectifying circuits in parallel, permitting current impulses of but one direction to flow through them, although the line current is alternating.

913,524. SUBMARINE MINE. Karl O. Leon, Stockholm, Sweden. Filed November 16, 1906. The mine contains a detonator, an electric battery normally on open circuit and a means for opening the casing and closing the circuit when the mine rises to the surface of the water.

913,528. SIGNALING SYSTEM. Robert H. Marriott, Brooklyn, N. Y. Filed May 12, 1908. A submarine sound-transmitting system consists of a bell at a transmitting station and a telephone transmitter at a distant receiving station, both being submerged under the water.

913,541. ELECTRIC MOTOR FOR HIGH-TENSION CURRENTS. Nikolaus Myschkin, New Alexandria, Russia. Filed October 30, 1908. In combination with a dielectric disc and dischargers arranged in oppositely directed series are means interposed between either series and the disc in order to render the series inactive.

913,542. TROLLEY SAFETY DEVICE. Henry Nannenhorn, Chicago, Ill. Filed April 15, 1908. In a trolley line there are inverted U-shaped members suspended from the trolley poles and provided with inverted U-shaped slots having pins movable in them that have blocks thereon and secured to one end of a section of trolley wire.

913,547. TURNBUCKLE FOR TROLLEY WIRES. Hugh S. Ollson, Mars, Pa. Filed October 10, 1908. Comprises right and left-hand screws, sockets carried thereby, a turn-buckle body adapted to screw upon the screws, and extensions carried by the ends of the body.

913,557. BLOCK-SIGNAL SYSTEM. George S. Pflasterer, Nashville, Tenn. Filed June 9, 1908. An electrically-controlled manually-operated signal and mechanism therefor includes a slot circuit and means preventing its energization except when a portion of the track on one side of the signal is free from trains and a portion on the other side is occupied by a train.

913,562. BRUSH SPRING FOR DYNAMOS AND MOTORS. John H. Poole, Washington, D. C. Filed March 19, 1907. A curved leaf spring has one end bearing on the rear face of the brush through an anti-friction roller arranged so that high-speed vibrations are not transmitted to the brush with any lateral components.

913,563. METHOD AND APPARATUS FOR REVIVIFYING DRY-CELL BATTERIES. Horace B. Ramey, Alexandria, Va. Filed June 30, 1908. Consists in cleaning and perforating the zinc casing, surrounding it with an imperviously coated absorbing material impregnated with electrolyte, and supplying water in the top of the cell.

913,566. ELECTRICAL FUSE SPITTER. John B. Sauve and Frank Bernardi, Mokelumne Hill, Cal. Filed February 19, 1908. Consists of a tubular cap adapted to fit a fuse, a solid plug of sulphur closing one end of the cap and having conducting wires passing through the plug to a point adjacent to the fuse and adapted to ignite it.

913,579. ELECTRIC BROILER. George E. Stevens, Lynn, Mass., assignor to General Electric Company. Filed October 16, 1907. Comprises an elongated heating unit and a number of parallel spaced strips mounted across it and in heat-conductive relation thereto.

913,584. CAM FOR LAMP-SOCKET KEYS. George B. Thomas, Bridgeport, Conn., assignor to The Bryant Electric Company, Bridgeport, Conn. Filed December 18, 1907. The key spindle of a lamp socket has projections with a cup-shaped cam of sheet metal drawn into oblong outline.

913,588. ADJUSTABLE COUPLING FOR ELECTRIC-INSTALLATION TUBES. Wheeler H. Vibber, New Lond n, Conn., assignor of one-half to The Gillette-Vibber Company, New London, Conn. Filed January 2, 1909. Near the ends of a coupling sleeve are slots in which lie binding straps with their ends overlapping and secured by screws.

913,595. SPARK PLUG. Fred H. Weinhauer, New York, N. Y. Filed October 22, 1908. Contains a shell electrode adapted to make connection with a cable.

913,607. TELEPHONE-CALL MECHANISM. William E. Zabst, Portage, Wis. Filed July 8, 1908. A motor controls the sections of a bell clapper so it may operate freely, partially or not at all.

913,613. CALL-DISTRIBUTING TELEPHONE-EXCHANGE DETAILS. Sidney H. Browne, Pittsburg, Pa., assignor to American Telephone and Telegraph Company. Filed August 3, 1905. Renewed July 18, 1908. Covers details of a switch, a magnet adapted to restore it to rest, a delay relay and a circuit, including the winding of the restoring magnet, a source of current and the contacts of the delay relay.

913,615. STREET-CAR TROLLEY-POLE WHEEL. Solon Bryan, San Diego, Cal. Filed June 20, 1907. A trolley pole has an arm pivoted thereto between its ends and adapted to swing laterally out of the line of the pole, a wheel being mounted on the outer end of the arm and means connected with the inner end of the arm for bringing the arm into line with the pole when desired.

913,616. ELECTRIC METAL-WORKING APPARATUS. Alvin E. Buchenberg, Toledo, O., assignor to The Toledo Electric Welding Company, Toledo, O. Filed June 25, 1908. An electric welding machine has sets of electrodes and means movable with and co-operative therewith to grip the work and to force its ends together when the electrodes slip in contact therewith.

913,658. APPARATUS FOR CHARGING OPEN-HEARTH FURNACES. Benjamin W. Head, Westminster, London, England. Filed November 10, 1908. The machine is driven by an electric motor.

913,666. DYNAMO-ELECTRIC MACHINE. Lamar Lyndon, East Orange, N. J. Original application filed July 6, 1905. Divided and this application filed October 2, 1906. Renewed May 18, 1907. An alternating-current axle-driven generator has the rotor mounted directly on the axle of the car truck and the stator independently and resiliently suspended from the truck cross-pieces.

913,669. BURGLAR ALARM. Charles G. Munsell, Sidney, Iowa, assignor of two-thirds to Alfred W. Hawver, Springfield, Mo. Filed August 15, 1907. A closed-circuit alarm system has its circuit-breaker arranged in a recess formed in the frame of a door or window.

PATENTS THAT HAVE EXPIRED.

Following is a list of electrical patents (issued by the United States Patent Office) that expired March 2, 1909:

469,672. ELECTROMAGNET. A. D. Ayres, Kalamazoo, Mich.

469,706. TELEPHONY. W. C. Lockwood, New York, N. Y.

469,712. DEVICE FOR CONTROLLING ELECTRIC MOTORS. A. L. Parcelle, Boston, Mass.

469,723. UNDERGROUND ELECTRIC CONDUIT. E. P. Robbins, Cincinnati, O.

469,725. DYNAMO-ELECTRIC MACHINE. E. A. Sperry, Chicago, Ill.

469,745. NON-INTERFERING FIRE-ALARM TELEGRAPH BOX. F. F. Loomis, Akron, O.

469,782. TELEPHONE TRANSMITTER. J. C. Goulding, Cardiff, England.

469,792. ELECTRICALLY-HEATED SMOOTHING IRON. W. Mitchell, Malden, Mass.

469,799. ELECTRIC LOCOMOTIVE. T. L. Willson, Brooklyn, N. Y.

469,800. ELECTRIC METER. J. J. Wood, Fort Wayne, Ind.

469,809. SYSTEM OF ELECTRICAL DISTRIBUTION. William Stanley, Jr., Great Barrington, Mass.

469,856. TELEGRAPH APPARATUS FOR BRANCH OFFICES. J. B. Hurd, Red Bank, N. J.

469,861. CONTACT DEVICE FOR ELECTRIC RAILWAYS. J. C. Love, Philadelphia, Pa.

469,862. ELECTROMAGNETIC MACHINE. R. Lundell, New York, N. Y.

469,865. Telephone SYSTEM. T. W. O'Brien, Wilkes-Barre, Pa.

469,905. ELECTRICAL RELEASING DEVICE FOR TARGET TRAPS. P. North, Cleveland, O.

469,917. ARMATURE WINDING FOR DYNAMO-ELECTRIC MACHINES. R. Eickemeyer, Yonkers, N. Y.

469,944. POWER-TRANSMITTING DEVICE FOR ELECTRIC RAILWAYS. E. H. Johnson, New York, N. Y.

469,949. ELECTRIC SOLDERING IRON. J. J. Ritter, Basle, Switzerland.

469,995. ELECTROMAGNETIC ANNUNCIATOR. F. W. Dunbar, Newark, N. J.

470,014. FUSE FOR ELECTRIC CIRCUITS. C. F. Scott and A. Wurts, Pittsburg, Pa.

470,073. ELECTRIC BATTERY. E. Ortell, Cadenabbia, Italy.

470,129. ELECTRIC RAILWAY SIGNAL. William Holloway, Jr., Wayne, Pa.

470,158. ELECTRIC ELEVATOR. C. J. Sturgeon, Erie, Pa.